From the Ceiling of the auditorium of the National Academy of Sciences in Washington, D. C

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"The Curve of Progress" (A Boring Mill)

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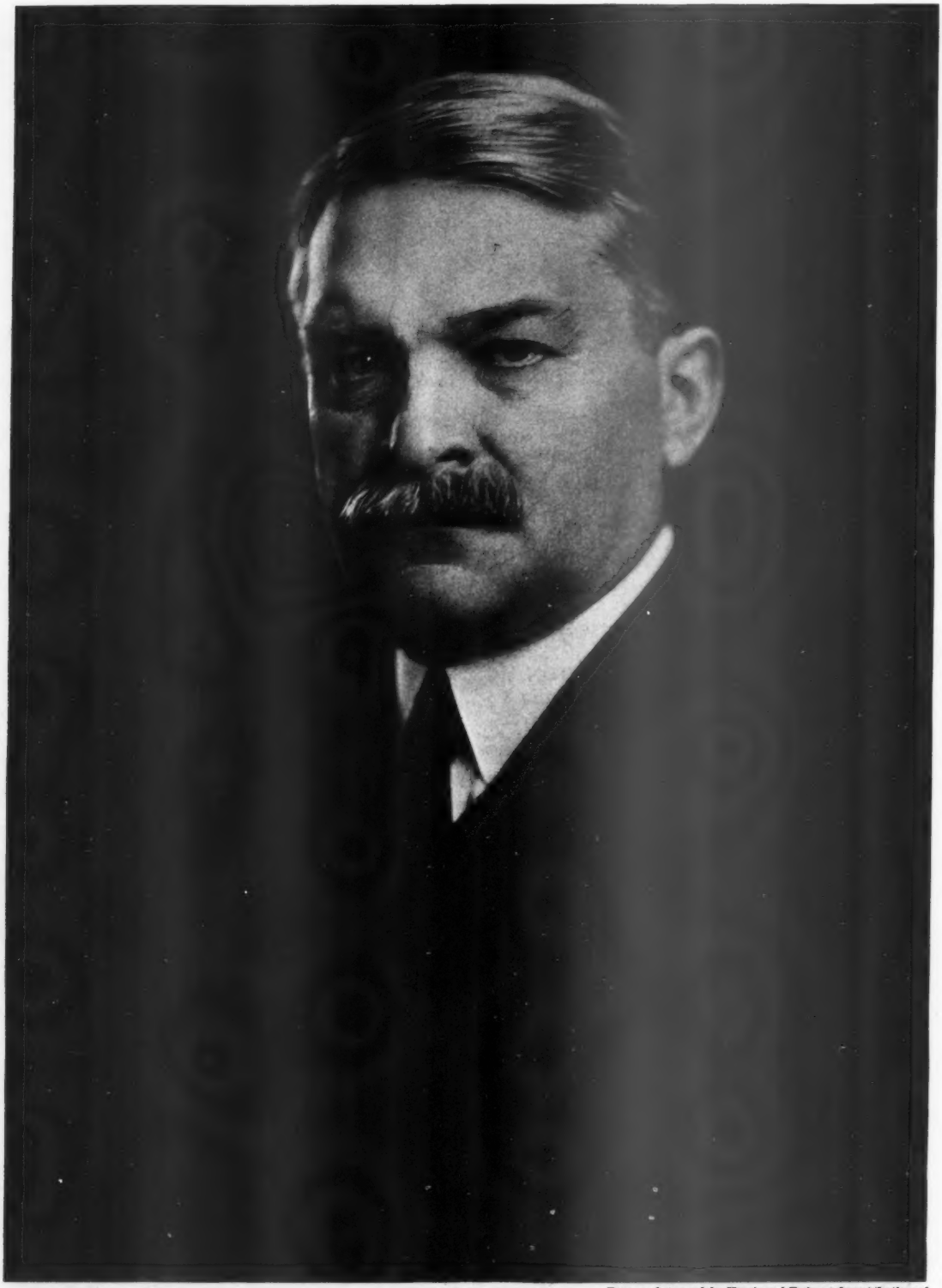

From a photograph by Harris and Ewing, taken at the time of Dr. Stratton's accession to the Presidency of M. I. T. (1923)

SAMUEL WESLEY STRATTON

July 18, 1861 — October 18, 1931

For an extended account of Dr. Stratton's life and his great contributions to science, industry, and to the Massachusetts Institute of Technology, see page 84

THE
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WINGÉD WORDS

Aviation Enriches the American Language

By Daniel C. Sayre

THE effect of specialized vocabularies on our general speech is one of the interesting linguistic phenomena of our day. The flood of terms which flows in from the fields of sport and of gangdom has frequently been the subject of comment. No less important in this technological age are the carrying over of expressions from the vocabularies of science and applied science. Of all such technical fields, those affecting that popular human occupation, transportation, have ever been the most fruitful. Imagine yourself without *safety valve, make the grade, step on it, put on the brakes, a mile-a-minute,* and a score of others with the transportation imprint. The present article deals with the next assignment in our language lesson, the jargon of aeronautics.

The purely technical, aeronautical nomenclature which gets into glossaries, such as that issued by the National Advisory Committee for Aeronautics, is no more interesting to the outsider than the technical language of any other industry, save that it seems inevitable that the next generation must know as much about *ailerons, pitching moments,* and *dihedral angles,* as the present one does about carburetors, differentials, and wheel bases, and as our fathers knew about surcingles and whiffletrees.

In the early years of the century when the vocabulary was in the first process of formation, there were three rather diverse sources from which new aeronautical terms were derived. The first was a small group of scholarly scientists, led by Langley and Bell in this country and Lanchester in England, who fought a rather unsuccessful battle for a complete nomenclature of classic or pseudo-classic words. The first two clung tenaciously to *aerodrome* as a name for the new heavier-than-air craft, a term which survives through some queer twist only as the learned word for an airport. More legitimate traces of this druggists' latin school are, of course, found in *aeronautics, aeronaut, ornithopter, helicopter, aerodynamics, aerostatics,* and some others. In England their success was somewhat greater and the root *aero-* is retained in *aeroplane, aerofoil,* and so on, where it has long since yielded to *air-* in America.

The second source was France, especially for names of the different parts of the airplane, such as, *aileron, fuselage, empennage, decalage,* and many of the original lighter-than-air terms; such as, *balloon, dirigible, ballonet,* and so on. The third is ordinary Anglo-Saxon words, newly used or newly compounded. The bulk of these, such as *landing gear* and *control stick,* are as uninteresting as the words screw driver and toothache, but a few show some imagination. *Ceiling* is used as the maximum altitude to which its power will permit an aircraft to ascend, or the upper limit of visibility from a navigation standpoint. *Barrel roll* and *falling leaf* are nicely descriptive of the maneuvers they denote, and the word *zoom* positively approaches onomatopœia.

However it is to the aeronautical vulgate, to the speech of the real air-going members of the populace that we must turn if we are in search of colorful language. Take for example a few verbs. After *reving up* his motor, the pilot *gives it the gun* and *takes off.* If his engine *poops* or *konks,* he will be *forced down* and is in

for a *dead-stick landing* and must *get into* the nearest field as best he may. Such are the chances of *cross-countrying*, and they are particularly bad when *ferrying the mail* through a *fog factory*, or when *pushing a crate* anywhere, even over a *Kansas*.

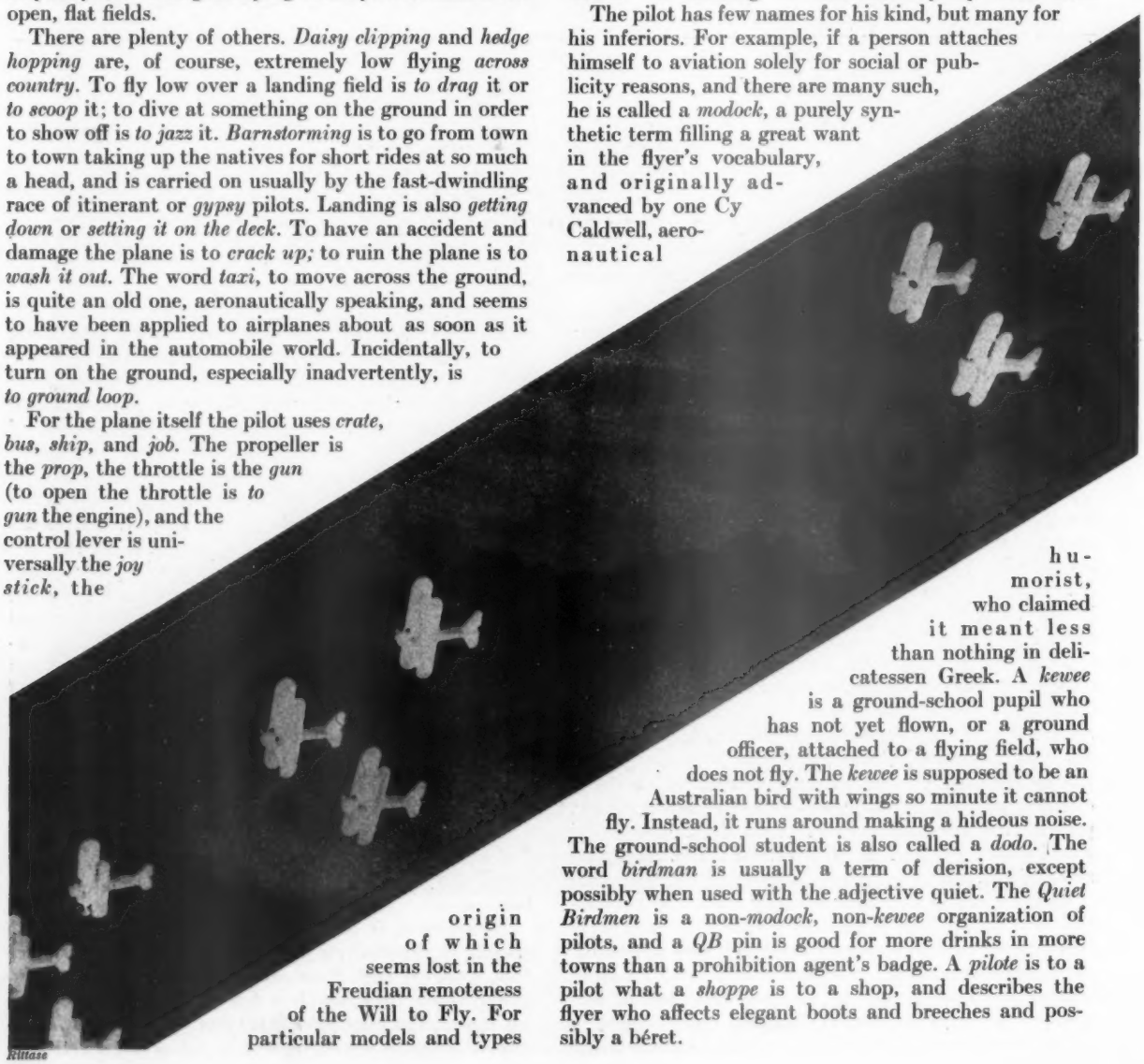
The meanings of most of these terms are apparent; some need explanation. After running his motor to warm it, finally testing it at its maximum rate of revolutions (*reving up*), the pilot opens the throttle governing the gasoline flow, or *gives it the gun*. If his engine loses power or stops completely, the pilot must land unwillingly with his propeller no longer turning, that is, *dead*. *Poop* is an ancient word; *konk*, I think, came from that class of comic-strip words like *zowie* and *pow*. Flying across country is never *crossing country;* a *fog factory* is a spot where fogs are common, such as Nantucket in the summer, western Pennsylvania, and San Francisco; *pushing a crate* is flying a decrepit airplane; and *Kansas* is synonymous with good flying country, *i.e.*, continuous, open, flat fields.

There are plenty of others. *Daisy clipping* and *hedge hopping* are, of course, extremely low flying *across country*. To fly low over a landing field is *to drag* it or *to scoop* it; to dive at something on the ground in order to show off is *to jazz* it. *Barnstorming* is to go from town to town taking up the natives for short rides at so much a head, and is carried on usually by the fast-dwindling race of itinerant or *gypsy* pilots. Landing is also *getting down* or *setting it on the deck*. To have an accident and damage the plane is to *crack up;* to ruin the plane is to *wash it out*. The word *taxi*, to move across the ground, is quite an old one, aeronautically speaking, and seems to have been applied to airplanes about as soon as it appeared in the automobile world. Incidentally, to turn on the ground, especially inadvertently, is *to ground loop*.

For the plane itself the pilot uses *crate*, *bus*, *ship*, and *job*. The propeller is the *prop*, the throttle is the *gun* (to open the throttle is *to gun* the engine), and the control lever is universally the *joy stick*, the origin of which seems lost in the Freudian remoteness of the Will to Fly. For particular models and types there are many nicknames. The Ford trimotors are *tin geese*, an amphibian is often a *duck*, and the unique examples labeled *Whistling Bill*, *Stuttering Sam*, *Andy Gump*, the *Galloping Goose*, the *Iron Horse*, and the *Bath Tub* earned their sobriquets by some peculiarity of construction, performance, or appearance. I can assure you that they are descriptive to the point of genius.

Bellanca, the designer, perpetrated a ship which was said to have on *plus fours*, or *tin drawers*, due to a feature of its landing gear which has since taken the generic term of *pants* on all subsequent designs. The word ceiling possibly suggested the pilot's term for aloft, which is *upstairs*. For instance: How's the weather *upstairs?* Parachute activities have produced the expression *to bail out*, meaning to climb out of the cockpit and go over the side. A successful parachute jump for the purpose of saving one's life in a legitimate emergency automatically enrolls one in the "Caterpillar Club." A training or exhibition jump does not.

The pilot has few names for his kind, but many for his inferiors. For example, if a person attaches himself to aviation solely for social or publicity reasons, and there are many such, he is called a *modock*, a purely synthetic term filling a great want in the flyer's vocabulary, and originally advanced by one Cy Caldwell, aeronautical humorist, who claimed it meant less than nothing in delicatessen Greek. A *kewee* is a ground-school pupil who has not yet flown, or a ground officer, attached to a flying field, who does not fly. The *kewee* is supposed to be an Australian bird with wings so minute it cannot fly. Instead, it runs around making a hideous noise. The ground-school student is also called a *dodo*. The word *birdman* is usually a term of derision, except possibly when used with the adjective quiet. The *Quiet Birdmen* is a non-*modock*, non-*kewee* organization of pilots, and a *QB* pin is good for more drinks in more towns than a prohibition agent's badge. A *pilote* is to a pilot what a *shoppe* is to a shop, and describes the flyer who affects elegant boots and breeches and possibly a béret.



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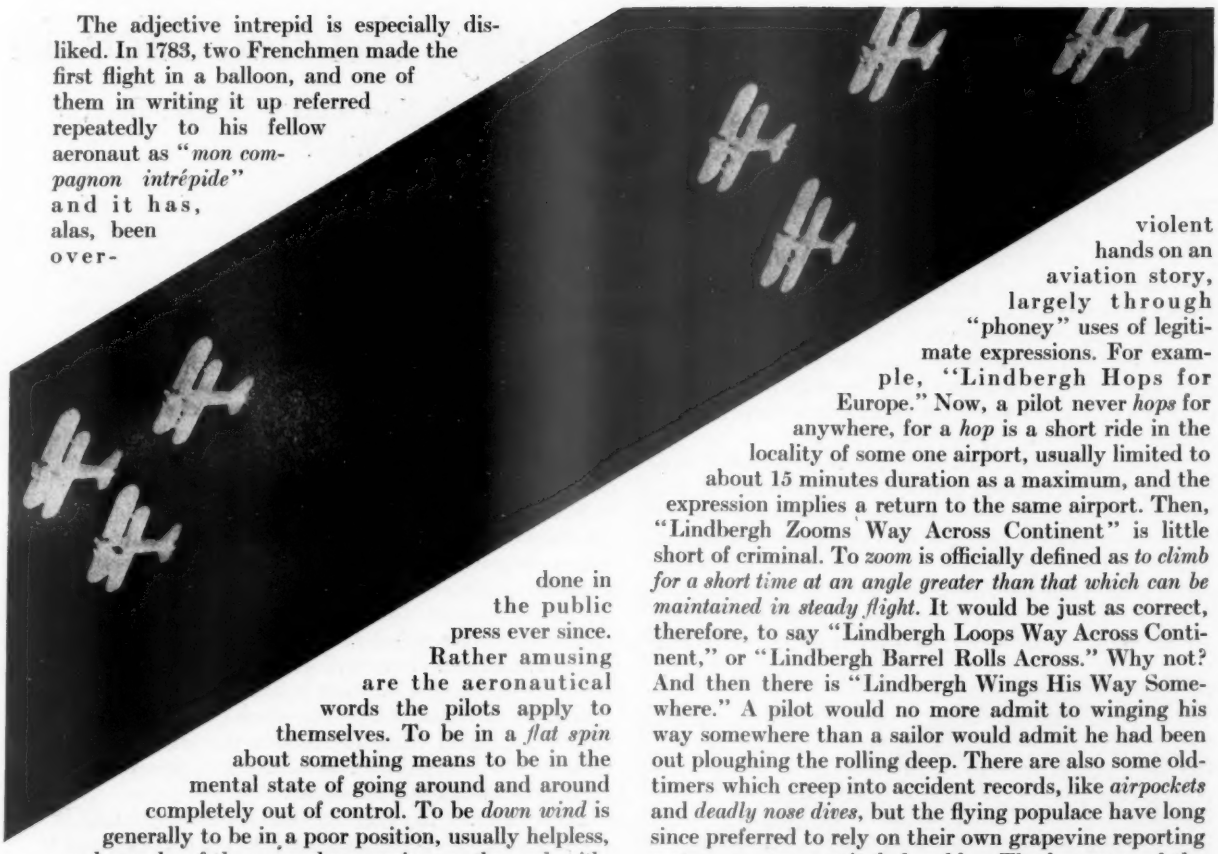


The adjective intrepid is especially disliked. In 1783, two Frenchmen made the first flight in a balloon, and one of them in writing it up referred repeatedly to his fellow aeronaut as "*mon compagnon intrépide*" and it has, alas, been overdone in the public press ever since. Rather amusing are the aeronautical words the pilots apply to themselves. To be in a *flat spin* about something means to be in the mental state of going around and around completely out of control. To be *down wind* is generally to be in a poor position, usually helpless, and smacks of the general expression *up the creek without a paddle*. As an adjective, *down wind* has the force of the general terms *no good, goofy, all wet, irregular*. Likewise, the expression *to test hop* is used interchangeably with the verb *to try out* and is applied to anything from a brand of cigarettes to a new girl friend. A *hangar* was originally any headquarters, but is now usually a speakeasy, or at least some place where drinks are being put out. *To be forced down at a hangar* therefore takes on the aspect of a bibulous afternoon or evening. Then, of course, you hear talk like: I was cruising along 43d Street when along came Bill, Sam, and Charlie in formation, and we all sideslipped into a speakeasy and did a lot of barroom flying, which is synonymous with *horizontal, bunk-room, or grocery-store flying*, and means general lying about personal aerial exploits.

Then we have the *going* and *pulling* expressions. *To pull a Lindbergh* means to do something heroic, but *to go Lindbergh* means to get the flying fever in a rather callow manner. Likewise, *to pull a Levine* is to lay an overemphasis on money matters. *To pull a Nungesser-Coli* is to disappear completely, as *to pull a Dole Derby* is to engage in a complete debacle of some sort. Likewise, *to pull a Mitchell* is to argue yourself out of a job, or to be generally uncomfortable to your superiors.

The journalistic dialect, when administered in special aviation departments by special editors, is in general good glossary *aeronautica*, supported perhaps by some of the more respectable vulgate. It is the headline writers, the general assignment and rewrite men who lay rather violent hands on an aviation story, largely through "phoney" uses of legitimate expressions. For example, "Lindbergh Hops for Europe." Now, a pilot never *hops* for anywhere, for a *hop* is a short ride in the locality of some one airport, usually limited to about 15 minutes duration as a maximum, and the expression implies a return to the same airport. Then, "Lindbergh Zooms Way Across Continent" is little short of criminal. To *zoom* is officially defined as *to climb for a short time at an angle greater than that which can be maintained in steady flight*. It would be just as correct, therefore, to say "Lindbergh Loops Way Across Continent," or "Lindbergh Barrel Rolls Across." Why not? And then there is "Lindbergh Wings His Way Somewhere." A pilot would no more admit to winging his way somewhere than a sailor would admit he had been out ploughing the rolling deep. There are also some old-timers which creep into accident records, like *airpockets* and *deadly nose dives*, but the flying populace have long since preferred to rely on their own grapevine reporting system on aeronautical shambles. The language of the vine is correct anyhow.

The pulp-wood authors are in that peculiar position in relation to aeronautics which is occupied by newspaper sports' writers in relation to their own subject. The baseball writer, for example, may not say: "With one batsman out in the third inning of the second game, the Boston Americans scored a run through a combination of two hits to right field and an error by the Philadelphia third baseman." He must say something like this: "After two lusty smackings of the apple to the right field sun gardens in the third frame with one down and a sad miscue by the Mackmen's hot corner merchant, the Pale Hose again had crossed the platter with what might have put the works on ice in the nightcap." No more may a writer of an air thriller say: "The plane taxied across the field and took off." It must go: "With a terrific roar from the 12 powerful cylinders under its sleek cowling, Noddy Nixon's great Blukker waddled across the tarmac and bit the air. 'Revs 1,650 Course N. by N.N.E.,' said Dan Baxter by his side, who up to this point had taken no part in the conversation." And so on, and so on. Obviously, another American case of overdeveloped demand resulting in a spurious supply.

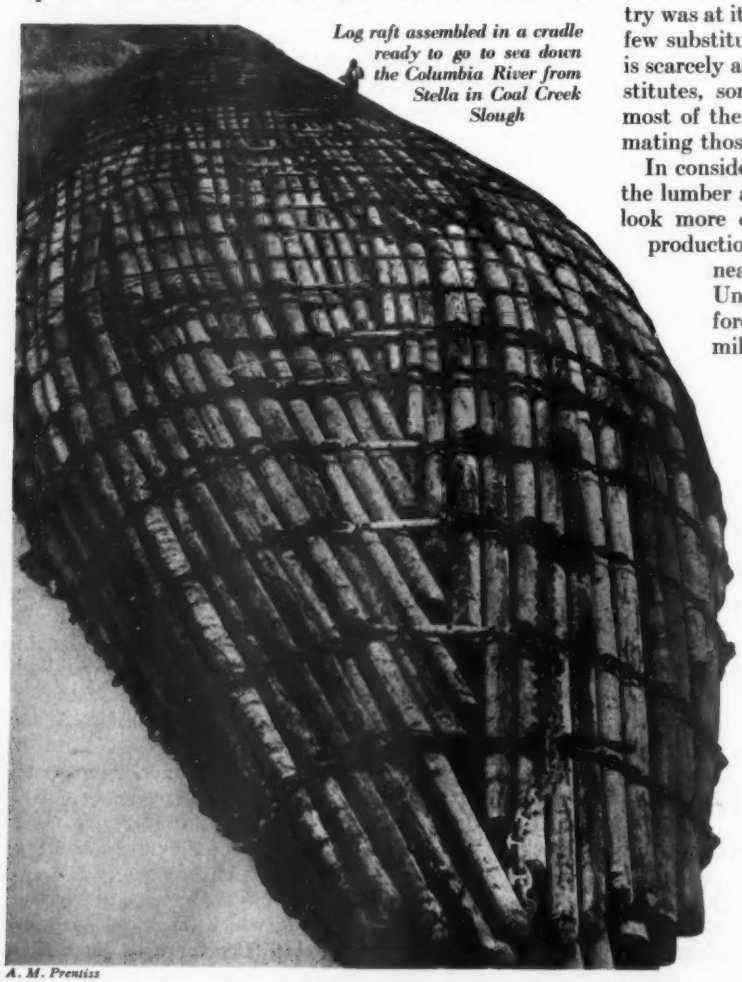
How much of all this language, no matter of what category, will eventually get into the general vocabulary is, of course, impossible to say. Already many full expressions have gone over. *Give it the gun* is already the modern version of *step on it*, which displaced *open the throttle*, which displaced *whip* (*Concluded on page 102*)

Opportunities for Technically Trained Men in

The Annual Production of Lumber in the United States Is Now Thirty Billion Feet; a Quarter Century Ago It Was 40% Greater. Why?

WOOD, by reason of its diversified natural qualities, is capable of being made the most universally useful of all the materials of industry. It is truthfully stated, on the other hand, that wood, during the processes of conversion of the standing forest into the finished wood article, is with few, if any, exceptions subject to greater losses than any other important raw material. In these two facts lie great present and potential opportunities for the application of science and research in the wood industries.

I ask you first to think of the lumber industry and of its present industrial and scientific problems in the light of the changing economic conditions of the last 30 years. A consideration of these problems reveals the following facts. It is the oldest American industry, established three centuries ago and sharing with the hardy pioneer the trail-blazing which gradually opened up the vast resources of the United States. It is the supplier of housing for 80% of the American people, and for three centuries the source of the favorite and almost universally used material of industry. It has been encouraged by habit to depend upon custom and established preference to keep its products in use; to rely, too much perhaps, on traditions in an age when people are breaking with tradition; and to depend on adherence to old styles when the public is eager for new styles. For decades it has remained almost contemptuous of science, considering it the work of theorists, whose ideas have little bearing upon the art of judicious timber purchase or of lumber manufacture.



Log raft assembled in a cradle ready to go to sea down the Columbia River from Stella in Coal Creek Slough

A. M. Prentiss

With this background, the lumber industry entered, a quarter century ago, upon what has proved to be a period of the most extensive and most vigorous competition for public patronage ever recorded, the seriousness and intensity of which become increasingly apparent. At the outset of this period, the use of lumber in this country was at its peak. For most of its important uses it had few substitutes, and in many it had none. Today there is scarcely an important use for which there are not substitutes, some of them for certain purposes superior, most of them readily available, and at prices approximating those of suitable lumber.

In considering the opportunities for technical men in the lumber and woodworking industries, it is helpful to look more closely into the present status of lumber production, distribution, and consumption. There are nearly two billion acres of land in continental United States. Originally, nearly half was in forest, but today only one-fourth (about 500 million acres) is forest land, supporting virgin timber and new growth, while on 100 million acres there is almost no timber at all. Of these lands, over 100 million acres are in public ownership, 150 million acres are owned by farmers, and the remaining half is largely in the ownership of timber and lumber companies.

The annual production of lumber in the United States is now about 30 billion feet; a quarter century ago it was 40% greater. There are now about 20,000 sawmills; 20 years ago there were over 40,000. About 1,000 mills, or 5% in number, produce over 60% of the total production of lumber. The Western States now produce nearly 50% of the lumber supply of the United States, and the proportion is increasing, but a half century ago, they produced less than 5%. Three-quarters of a century ago the Northeastern States produced 60% of the lumber supply; they now produce less than 4%. The Southern States now supply over 40%; a half century ago,

the Wood Industries

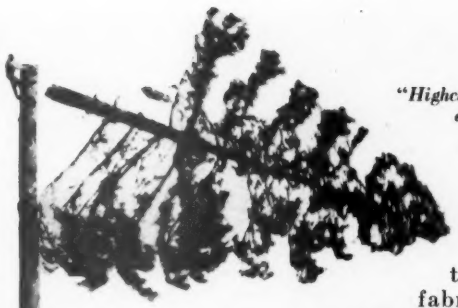
By Wilson Compton

only 10%. Such have been the distinctive geographical shifts in the sources of lumber supply.

Of the 20 leading American industries, not including agriculture or the railroads, lumber and its manufacturing industries rank second in the number of persons employed, third in the extent of its investment, and eighth in the value of its products. But in these industries the annual value of products is only 25% of the aggregate value of their investments in timber and plants. In the automobile industry, at the other extreme, the annual value of products is 50% greater than the aggregate capital invested in automobile manufacture. Of the ten largest American industries, only one shows as low a ratio of value of annual product to aggregate investment as does the lumber industry. Herein lies one of the lumber industry's most difficult economic problems; *i.e.*, a relatively high percentage of fixed assets, and, in relation to annual income, a high ratio of investment in tangible property subject to increasingly heavy annual taxes, and a need of relief from multiplying capital carry costs, through quick liquidation. This is at the foundation of the present familiar, costly, and wasteful trend toward overproduction in the lumber industry, reflected throughout the various fabricating, wood-using industries.

I have already referred to the losses in present-day wood conversion processes. Of the average tree cut for lumber manufacture, one-fourth, including defective trees, tops, limbs, and stumps, is left in the wood unutilized because there is no present use for it. Of the log brought to the sawmills, one-fourth, consisting largely of bark and the saw kerf, is not utilized except for fuel. Another fourth, consisting of slabs, edgings, and trimmings, is usually converted, so far as possible, into by-products, such as lath and miscellaneous small dimensions. The other 50% of the log emerges in the form of rough lumber.

Nor does the loss of material end there. When the finished lumber itself is used, the further fabricating losses in building usually range between 5% and 15%; in box manufacture, between 10% and 15%; in car construction, about 10%; in furniture making, nearly 25%; in the wood-using industries, generally an average of 30%. Of the total wood content of the average tree, therefore, as it stands in the woods, only 35% in its finished form is finally used in ordinary building, and less than 30% in the more exacting manufacture of finely fabricated wood products. These facts give a fair, quantitative measure of the stupendous physical opportunities for more complete utilization of raw material in the wood industries.



"Highclimber" topping a fir spar

IN LOGGING and milling lie great opportunities for the forester, logging engineer, efficiency engineer, mechanical engineer, and transportation expert. For the forester, there are the problems of cutting and managing the timber stands so as to regenerate the species and the qualities of individual trees which will yield the highest financial return. These men must be versed in silviculture and silvics, in methods of natural and artificial reforestation, in the properties of the different kinds of woods, and in the requirements of the industries dependent upon wood as a raw material.

For the logging engineer, there is the problem of determining the logging equipment, its installation and the manner and means of its use which will permit conservative logging at the lowest cost. The logging and efficiency engineer should carry on studies to determine, for example, which type of equipment for felling the trees, for skidding logs, and for transporting them to the mill, should be used under the varying conditions of density of timber stand, species, topography, accessibility to mill, and availability to natural means of transportation. They should determine the relative profit in cutting and logging trees of different species, different diameters, at different relative distances from the point of converting the log into sawmill products. Too often the wood losses in logging are due to inefficient equipment or rule-of-thumb logging methods.

A portion of the loss of material in the sawmilling processes, aggregating nearly 25% of the volume of the log, is due to inefficient or inadequate machinery and equipment and to antiquated methods of mill operation. Here again the engineer has an important place in the lumbering operation, in studies of the milling operation itself, of sawmill machinery design and installation. Manufacturers of sawmill

A. M. Prentiss

Brubaker Aerial Surveys

A lumber mill at Klamath Falls, Ore.

machinery are giving constantly increasing consideration to the need of refinement in their products and of technical skill in their use in the lumber and wood-using industries.

There are, nevertheless, regularly produced and sold to lumber manufacturers by the sawmill machinery manufacturers circular saws which consume saw kerf as thick as 6/16ths of an inch, whereas properly installed steel band saws of slightly over 2/16ths of an inch will do the sawing even more accurately. There is still in wide use equipment which unnecessarily damages both logs and lumber in handling at the mill, edgers and trimmers so set or so operated as to cause unnecessary waste in wide edgings or long trimmings. More than ten thousand portable, circular sawmills are ordinarily in operation in the United States. They produce a third of the lumber. In the milling operation, generally and with only a few exceptions, they waste more of the content of the log than they save in the form of lumber.

The distribution of lumber from the sawmill to the wood-working plant and other points has wide ramifications. The largest markets for lumber are located from 1,000 to 3,000 miles from the most plentiful timber supplies. Improvements in transportation and distribution methods will, of course, place wood at the primary fabricating plant at lower cost. The primary lumber and timber product of the United States has an annual value of somewhat less than a billion dollars, and it costs nearly half a billion more to get it from producer to consumer. Probably the greatest single advance recently made in reducing the cost of lumber to the wood-fabricator is in the field of dimension cuttings. In this process the defects are cut out at the source of production, expensive transportation costs on waste are avoided, and cut-to-desired-dimension stock is made available to the wood fabricator.

THERE are in the United States some 600 different species of trees, though not all of these 600 kinds attain sufficient size for lumbering. Many of similar wood characteristics are grouped commercially and, for ordinary purposes, are indistinguishable. The user of wood, therefore, finds available to him some 100 different kinds, of which about 30 are important.

Each species of wood has some 40 separate and distinguishable properties. Twelve of these are mechanical properties, such as hardness or softness, strength, toughness, and stiffness; 18 are physical properties, such as shrinkage, resistance to decay, weather or insect attack, heat and sound insulating properties; and ten are chemical properties, such as volatility of woods, permeability, combustibility, and the characteristics of its extractives and its distillation products. These mechanical, physical, and chemical characteristics may occur in so many varying combinations in the various species as to provide wood suitable for the 4,000 diversified commercial uses which I have mentioned. There is no other material which has the wide range of properties to be readily secured in a proper selection of the different species of wood for their proper purposes.

Of the 30 billion board feet of lumber produced annually, about one-half goes directly into light and heavy construction, the type of use in which the structural engineer, the architect, and the builder are primarily interested. The other half is further fabricated, treated, and refined. Important among these are planing mill products and general mill work, boxes, furniture, musical instruments, tanks and silos, railway cars, caskets, ships and boats, and some 35 other well-recognized, broad classes of wood articles. I need only point out that the conversion of lumber and wood stock into these highly refined articles presents an enormous problem for the wood fabricator.

There is another large class of uses for wood in which the wood itself does not pass first through the form of lumber. Much of this material would otherwise not be put to good use. I refer to utilization through chemical means to produce wood pulp products, plastics, and other chemical derivatives of wood, cellulose and lignin — those mysterious substances of wood which present a field of exploration, of which only the fringes have been so far touched by scientific research.

I believe we are entering upon an age of cellulose which promises an industrial "Battle of the Giants" in the next quarter of a century. The winner may be determined largely by the success of scientific research in mastering the mysteries of cellulose and lignin. Cellulose in the form of wood may be produced readily throughout the United States (*Continued on page 90*)

BENJAMIN THOMPSON: COUNT RUMFORD

His Romantic Career in Statesmanship and Science

By Richard W. Hale

BENJAMIN THOMPSON, born in the small Massachusetts town of Woburn, just north of Boston, rose to be Prime Minister of Bavaria; following on that he continued a romantic career in statesmanship and science. He was Count Rumford of the Holy Roman Empire, a member of the Order of Saint Stanislaus of Poland, and of the Order of the White Eagle. He ruled Bavaria as prime minister. Then he was accredited as Bavarian minister to Great Britain. In later life he was a famous scientist, a leader in thought and action, known, admired, and followed throughout the civilized world. When he was prime minister of Bavaria it became his duty to accomplish certain results, and to bring those about he found it necessary to invent the common kitchen range upon which we all cook today. No chimney need smoke if his observations upon that subject be heeded. But if one were asked, in our modern competitions designed to measure ignorance, to identify Rumford, the answer would probably be that it was a manufacturing city in Maine or a baking-powder from Rhode Island.

The Gainsborough portrait of Count Rumford recently bequeathed to Harvard University by the late D. C. Converse

While his influence upon history and upon human comfort was great and lasting, yet he did not appeal to the popular imagination and has passed out of common knowledge. I write about him to dispel the resulting ignorance. The material is ample, but has been abused and neglected.

His father and mother were honest though poor. Experts in New England genealogy have provided the usual pedigree, but it proves nothing other than the expected. Massachusetts, in 1753, when the boy was born, was full of Yankees about whom all the usual things could be said. Their emigrant ancestors had all come over the sea in the great movement which began in 1630. The later generations had been fighting the New England soil for a living during every season of the following hundred years. Benjamin Thompson might have been born into any family of this type or in any Massachusetts town. He first appears in history when he is three years old, fatherless, his mother married again. He is B. Thompson of Woburn. Of course he went to common school, and when he was 13 he knew the Three R's. But there are some visible distinctions between Thompson and the common New England boy of his age and time. From the very beginning writing and self-expression appear to have been easy things with him. At this age of 13 he became an apprentice in a little store on Essex Street in Salem. We call it little because we know that the employer, John Appleton, kept store in his own house. But it probably was not humdrum or monotonous. Appleton dealt in manufactured goods imported from England, and he probably also kept whatever a general store used to keep. The distinctions of those times were clear. There were only two kinds of goods for sale, English or manufactured goods and West India goods — West India goods including sugar and molasses and something which it is not easy to get in Salem nowadays except by stealth. These, then, were naturally wet goods, and it became easy to speak of English or manufactured articles as dry goods. Appleton's was primarily a dry goods store. After a year or two of the boy's experience in this apprenticeship his guardian writes to his employer, saying:

> "Thompson has wrote to me diuers times about his affairs. He saith he hath Sum priuyledge of trade for himself, and that you, Sir, would let him have sum fish to ship."

There is a whole biography in those phrases. And the circumstances of all merchandising at that time supply romance. We are talking about the West Indies and the slave plantations. For when an apprentice wants upon his own account to have "sum fish to ship," the mercantile scheme is to send salt cod from the New England fisheries to the West India plantations. It was the standard slave ration.

Our young Benjamin himself places at about this time the changes which make him distinct from the ordinary run of New England boys. In his reminiscences he describes his start:

> "A very responsible minister of his own prompting undertook to instruct me. He taught me even higher mathematics. Before the age of 14, I was able to calculate and trace rightly the elements of a solar eclipse. My computation was correct within four seconds . . . my thirst for knowledge became inextinguishable."

That was a prime minister looking back upon his modest beginnings. What a story it is! And at this age also he invented machinery for perpetual motion, although not even his genius could make a go of it.

We are fortunate in a description of this machine from a distinguished source. He had a constant friend in America. Probably no one today could identify this friend if I simply called him Loammi Baldwin, but those wise in history know his distinguished career, and his

From a caricature by James Gillray (1800)

Science and the practical arts furnished much material for Gillray's ribald caricatures. What he calls here a Rumford stove is probably a Rumford fireplace. It is Rumford himself who is enjoying the comforts

name still exists to identify the apple which now makes him famous. Colonel Loammi Baldwin, as a childhood friend of Thompson's, describes this perpetual motion device from his own knowledge. It was "a combination of wheels and mechanical powers, parts of which the writer has often seen but was never able to gain any information concerning the principles upon which it was expected to act." "Such was his [Thompson's] zeal in the execution and such his confidence in the success of this little contrivance, that he traveled from Salem to Woburn in the night, the only time which was afforded him, to communicate this scheme to an old schoolfellow." The old schoolfellow was Baldwin himself. To astronomy and to mathematics Thompson at this time also added fireworks. In this line he had a painful experience. When the town of Salem rejoiced over the repeal of the Stamp Act they apparently gave this boy charge of the fireworks. At any rate, they called upon him for a "style of extraordinary and unparalleled brilliancy and impressiveness." And he responded to the call with such zeal that the fireworks blew him up. The damage was serious. It put him upon the danger list and sent him home to Woburn. After his convalescence he appears to have gone to Boston, and found a new employer, Mr. Hopestill Capen, who kept shop in the little building still standing which contains easily the best fish restaurant in New England. I mean the Union Street Oyster House, and those who refresh themselves there are entitled to imagine Benjamin Thompson keeping shop upon the same floorboards. They are old enough! (Alas! the antiques go. There has been a new floor since this was written.)

But just before taking up mercantile life in Boston, Thompson made the best of a great opportunity. There were then lectures at a place which was quaintly known as part of the University at Cambridge. The particular part to which I refer was called Harvard College, and in that College (a word which probably meant the bricks and mortar now Harvard Hall) there were lectures in physics, called experimental philosophy. Loammi Baldwin and Benjamin Thompson attended these lectures from Woburn, going and returning upon foot. At home they built their own apparatus in order to repeat the experiments which they saw at Harvard. On these walks they passed an apple tree near the Woburn town line bearing fruit which was noticeably excellent. Years afterwards Colonel Baldwin remembered this tree and took scions from it to a local nursery.

WHILE young Thompson was working in Boston at dry goods he kept a regular boy's blank book, the finest sort of unconscious autobiography. Later he had a fond wife of whom he was by no means equally fond, and she preserved this book and transmitted it to us. It was her belief that it was a precious relic of a godlike genius. We regard it rather as a most manlike autobiography. In it we find upon the same page both "The composition for rockets, serpents and raining fire" and also the sapient reflection that "Love is a noble passion of the mind, Love."

A "School to Learn the French Language" jostles a thrifty transaction where Benjamin appears to have made money speculating in pew rents. That is followed before long by a graphic diagram of "Direction for the Backsword," and soon after comes a list of the expenses involved in purchasing parts of an electrical machine. Further on is the record of the boy's departure from dry goods into the study of medicine, and yet further we get our first, but by no means our last, evidence that Benjamin, in spite of all his erudition, kept clear of the class in which we find Mr. Dryasdust. The record shows that the boy paid 15 and a half cords of wood for "a blue Huzza Cloak bought of Zebediah Wyman." From this we have the reflection of one light which shines over Rumford's whole career. His destiny was very largely affected and his success promoted by his skill and power in interesting and charming others. His personal presence was always of the best, and he knew how to use it. Nor did he confine himself to one sex. Whenever throughout his long career there was somebody from whom he needed sympathy, friendship, affection, love, or money, his extraordinary powers and charms helped him to what he wanted. Beginning with the guardian and employer who were persuaded to let him have "sum fish to ship," and ending, perhaps, with the rich widow who was his second wife, he knew how to use others.

In his time you could not get educated without teaching school. Wherever Benjamin Thompson taught he was wanted again. Indeed, they seem to have heard about him each time a little farther from Boston and to have called him to something a little more distant and a little more successful, and so he moved north as he

taught until Colonel Timothy Walker of Concord, N. H., sent down for him. He taught some things out of school, and he carried his charm with him. Colonel Timothy Walker was also the Reverend Timothy Walker, and he had a daughter, and the daughter was 33 and a widow and had her late husband's fortune. Thompson was 19. She did not remain single 365 days between the rich first husband, who was 18 years older than she, and the handsome second husband who was 14 years younger. The first was Colonel Paul Rolfe. He had been the first private owner in New Hampshire of that particularly fine sort of carriage which was called a "carriole." And we are bound to observe and admire the celerity with which Benjamin Thompson promptly annexed both the lady and the carriage. In later life, reminiscing about the incident with the reflections of 25 or more years of experience, he acknowledged to a French philosopher that she married him. His word is supported from an independent source. In a town like Concord and a state like New Hampshire there is extraordinarily persistent gossip passed down by word of mouth until it becomes history, and that gossip agrees, saying specifically that the lady popped the question.

OTHER notes and memoranda of the new and young husband indicate that about this time he replaced the blue Huzza cloak. At any rate he possessed a "very good Hussar cloak faced with scarlet shalloon, with yellow, mock-spangle, metal buttons," and at about this time he also possessed a "plaid red gown, lined with Crimson shalloon." He went to Boston on his honeymoon, doubtless in the carriole, and the same long-persistent gossip of Concord has preserved a vivid picture of his call upon his mother in Woburn upon the return trip. He drove the carriole up to her door and claimed her blessing. Now remembering that the bride was substantially the same age as the groom's mother, we should realize that to the unprepared eye of the lady there came out of the clear sky the sight of her Benjamin dressed in scarlet shalloon, accompanied by a bride upon whom that scarlet may well have cast some reflection. The story ends happily, but in the beginning the mother could not believe in anything except the scarlet before her.

On the bridal tour the pair went to Portsmouth, N. H. Portsmouth was the capital of the Province, the center of aristocracy, ship-owning, and commerce. Even at that date it had had a most interesting history. Far excelling any other social center in the Colonies, it was the home of men who lived their lives of leisure upon their returns from land. The original New Hampshire charter was a grant to Mason like the grant of Pennsylvania to Penn, and a descendant had sold all the land of the Province to a quite modern syndicate called the "Masonian proprietors," monopolists who took tribute from every township that was settled, as New Hampshire grew and extended toward the north. The first citizens of Portsmouth were the real thing in upper crust, and Governor Wentworth was the top of the loaf. On November 13, 1772, Wentworth had a grand military muster at Portsmouth, and there he first set eyes upon our young benedict. Benjamin Thompson was on November 14 a guest at dinner at the famous Wentworth mansion.

The long series of promotions and titles begins, and the boy, B. Thompson of Woburn, who wanted "sum fish to ship," disappears into Major Thompson of the Second Provincial Regiment of the Province of New Hampshire. The incident throws a vivid light upon the gentleman's career. He had the power to charm, he ingratiated himself with others easily and excelled in social deftness. But we must admit that he always looked upwards, and never downwards. A wise old saw of his New England countryside offers the advice that one should "keep the hair of every dog growing toward its tail." But even in his own interest and to advance his own career Thompson never had the capacity to smooth the hair of the under-dog. Every officer who lost his promotion by having a major suddenly inserted into the regiment after a Governor's dinner party, every private who hated a scarlet-shalloon dandy, and indeed every being of the human kind who stood a rung or more of the ladder below our hero must have watched his rise with a justified antipathy. Not even a dog's bone of conciliation was thrown downward from Thompson while he was pushing forward upon his ingratiating and upward way.

Loammi Baldwin describes Major Thompson:

". . . he never appeared at public entertainments or in fashionable circles without being respectfully noticed. His genteel appearance and manly, impressive address, attracted the observation of many. Among others he was particularly noticed by the governor, Wentworth, who invited him to his party and never spoke of Mr. Thompson but with delight."

From a caricature by James Gillray (1802)

Gillray's famous caricature of the Royal Institution. The man holding the bellows is Humphrey Davy and Rumford is standing at the far right with a medal on his coat

Among Governor Wentworth's parties, or proposals for parties, was a scheme for a summer in the White Mountains which was to be half joy-ride and half scientific survey. But it never came about. Major Thompson went back to Concord, and there, at home on his wife's broad acres, we find him as a gentleman farmer. He calls them his own land, and today, if you inquire in Concord, you will find that her house is called his.

Upon an aristocrat so out of place, the Revolution, breaking loose, unchained those same under-dogs. They drove Thompson out of Concord, then out of the Province of New Hampshire, then into a sort of qualified arrest or restraint, then into the military lines of the Royal forces. He boarded an English man-of-war in Narragansett Bay and came around to Boston as a loyalist refugee and one of the efficient defenders of the town. Thence, with the deftness which we have praised already, he quietly moved back to England at the right time, carrying dispatches which introduced him into the right place. And it was a fat place, to be envied the young Colonial by every English placeman.

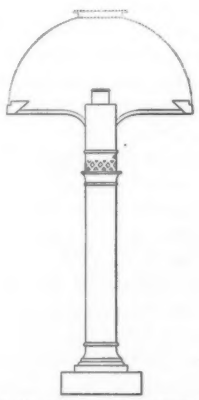
The thing which started the barking of democratic under-dogs against the young aristocrat was an incident about two deserters from the Royal forces. General Gage and Major Thompson were friends, and when two deserters from the British army arrived in Concord feeling like fish out of water and quite unwilling to remain among the Colonials, Thompson sent them back to Gage with a friendly request for clemency. But the consequence was a charge amounting in substance to one of treason. As it was expressed in the quaint form of the time, he was charged with "a suspicion of being inimical to American Liberties." His guilt is not important, for the common people of Concord had a cordial and universal belief that he was guilty and evidenced it by tendering him a shivaree, which is "a serenade of rough music with kettles, pans, tea trays, and the like . . . in mocking and derision . . . of unpopular persons generally." Powerful as the Walker connection and Thompson's other friends were in Concord and in New Hampshire, they advised him to run. Woburn was the place to go to, for there the "Committee of Correspondence and Safety" was dominated by Loammi Baldwin. At Woburn Thompson was subjected to something in the nature of a trial. The proceedings were complicated and long drawn out. He appears to have been received with tolerance and to have been allowed his freedom. He convinced the local committee of his innocence; at any rate they certified that he had satisfied them "by the strongest assurances of his good intentions." He was present at the battle of Lexington, was with the American army at Cambridge, and the official history of Harvard College expresses gratitude to him for being "instrumental in preserving the library and philosophical apparatus when the 'colleges' were converted into barracks." "College," in those days meant the buildings, and the institution was "The University at Cambridge."

From the "Works of Rumford" published by the American Academy of Arts and Sciences

Rumford's drip coffee pot. Coffee connoisseurs should by all means consult his essay "The Excellent Qualities of Coffee"

AND at Cambridge Thompson tried his charm and social skill upon George Washington and sought to become the commander of the American artillery. It may have been pique at his failure, it may have been a sound conviction that an aristocrat of his feelings was in the wrong place, or it may have been the conclusion that he would always be suspected. But, whatever the circumstances, we observe a marked contrast between Loammi Baldwin's complete verdict of acquittal and the flight which is the most conclusive of confessions. Thompson soon drove secretly to Narragansett Bay and there went on board the British frigate *Scarborough*. Thence he came around to Boston. When Boston was evacuated by the British troops he managed to be sent to England with dispatches, and again we have his own account of the successful advancement, polished, perhaps, by the French philosopher and friend whose words we quote "By the gracefulness of his manners he insinuated himself so far into the graces of Lord George Germaine that he took him into his employment."

He fell upon his feet, and he knew how to stay there. He soon held the position of under-secretary of state under Lord George, and we are told that his place was considered by the placemen worth seven thousand pounds sterling by the year. Perhaps this is magnified by the jealous, but it was a good place, and he stuck to it and did his work well. He was not only efficient, but he had a desire and a power to make others efficient. It is hard to think of him as the running-mate of the inefficient Lord George. Nero fiddling when Rome was burning has its parallel in Lord George week-ending when America was setting herself free. The pair must have been an odd one, Germaine, the useless aristocrat, balanced by Thompson, the deft and skilful genius. Here was an under-secretary of state who had the brains to understand the importance of a curious thing called a bayonet and, more than that, had the social skill and the diplomacy to break down the British habit of going without improvements and to secure the adoption of the bayonet as part of the equipment of the Guards themselves! The placeman not only did that, but also made a study of gunpowder and its efficiency which advanced knowledge and promoted operations both by sea and by land. And then, when the patron fell, the true gentleman

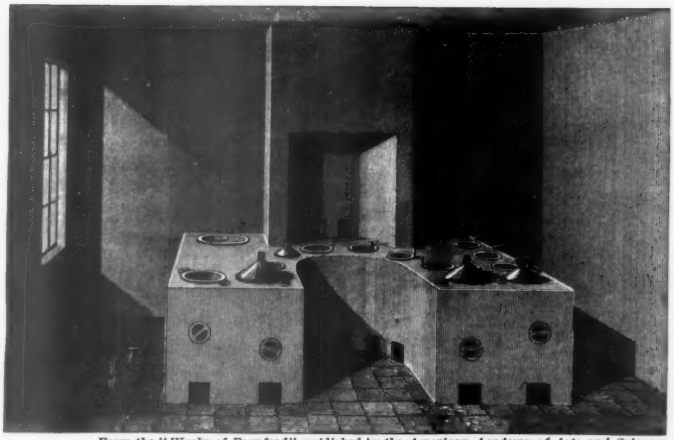


From the "Works of Rumford" published by the American Academy of Arts and Sciences

This "table illuminator," first presented to the public in 1811, was one of the simpler contributions which Rumford made to the management of light

went back to America to fight. Incidentally, he invented a new code of signals, wrote with effect upon naval architecture, and received the unusual honor of election as a member of the Royal Society. And on the voyage out to America he continued his experiments with gunpowder.

He served in the south against our free-lance Marion, and he had an extended period of service in northern Long Island, where he behaved with a ruthless efficiency which has filled the local historian with querulous complaints. For instance, he had a gunner's eye for the right place to put a fort, and so at Huntington, finding the place of vantage occupied by a graveyard, he put the fort on the graveyard. The Meeting House lying convenient, he used it as material. The tombstones came in handy for fireplaces and ovens. Among the thousands of American histories written in unreasoning praise of particular localities, we find a monument of erudition known as "Prime's History of Long Island," and Mr. Prime tells us that he has "often heard old men testify from the evidence of their own eyes, that they had seen the loaves of bread drawn out of the ovens with the reversed inscriptions of the tombstones of their friends on the lower crust." The soldiers had good bread, and the regiment a good commander.



From the "Works of Rumford" published by the American Academy of Arts and Sciences

One of the "kitchen fireplaces" designed by Rumford

HE ENDED the war as a full Colonel holding the King's, and not a Provincial, commission, and was put upon half pay. When he was seeking his last promotion, we find him writing to the man above him who had the good things to give. He addresses "His Excellency Sir Guy Carlton, K. B., General and Commander-in-Chief of all His Majesty's forces in North America within the Colonies lying in the Atlantic Ocean from Nova Scotia to West Florida, inclusive, &ca," saying: "This rank to me is of infinite importance as I am going abroad in a short time with a view to foreign service. But the half pay is also an object, as I have little else to depend upon except my industry." Upon the conclusion of the war he returned to England. But we see nothing of his movements until we meet him crossing the Channel. By good luck for us he crossed in the same vessel as the immortal Gibbon, who writes to Lord Sheffield from Dover, September 17, 1783:

"The triumvirate of this memorable embarkation will consist of the grand Gibbon, Henry Laurens, Esq., President of Congress, and Mr. Secretary, Colonel, Admiral, Philosopher Thompson attended by three horses, who are not the most agreeable passengers."

With the three saddle-horses Colonel Thompson arrived at Boulogne and went thence to Strasbourg. The scene with Wentworth at Portsmouth repeats itself. There was a military review. And there was a French field marshal who had also rank, standing, and connection in Bavaria. Thompson went forward with a warm letter of introduction from the field marshal to the Elector of Bavaria. Then he took a look in at Vienna, had some thought of campaigning against the Turk as an Austrian soldier of fortune, thought better of that again, and in a few months was back in England, where he applied to King George III for permission to enter the Bavarian military service. The stubborn king gave him not only permission, but a leg up, the rank of knighthood, which must have been of most substantial importance when Thompson presented himself upon the continent with that "view to foreign service." And not content with the rank itself, our new knight went to the Herald's Office and there purchased for himself upon the usual terms of cash down the right to use the arms of "the antient and respectable Family of Thompson of York." Thus secure from any confusion with the ancient and respectable family of Smith of Great Britain he returned to Bavaria and began his continental military life as colonel of a regiment of cavalry and general aide-de-camp to the Elector himself. He had half a palace assigned to him and a whole staff of servants. By 1788 he was major general and member of the Privy Council and head of the War Department. Then comes a curious story about the heraldic history of the Holy Roman Empire and B. Thompson gets his patent of nobility. A mere Elector of Bavaria is not enough of a sovereign to grant titles within the Empire. But while the Emperor's throne is vacant, one Elector becomes Vicar, or acting head of the Empire, and as such the Bavarian ruler became able to gratify his friends. B. Thompson of Woburn, Middlesex County, makes his last bow, and from now on we have Count Rumford.

WE MAY well pause here to consider what the man has come to be. He is just entering upon an extraordinary career of governing and of science, and he carries both forward, especially the latter, through his succeeding years. His most marked characteristic is that insatiable curiosity which is supposed to be the unmistakable mark of the Yankee. But it is also the curiosity which the modern philosophy of education considers to be the most essential quality for productive power. No person and no object passed under his eye without the most intense inquiry. The reason that he was successful in government and in science was that he had trained this genius of curiosity so that he inquired and philosophized about the very smallest of things, whether or no they had the surface appearance (*Continued on page* 93)

THE TREND OF AFFAIRS

IN THIS SECTION: Reducing Exercises for Fat Buildings (77); *Non-Magnetic Watches* (79); *Vodka Cement and Wine Concrete* (81); *Giant Spectroscope* (81); *Survey of Schneider Cup Races* (78); *The Coconut Challenges the Cow* (76).

Coconut Dairy

COPRA and coconut oil, which are among the principal exports of the Philippine Islands, the Dutch East Indies, and Ceylon, and of which the United States is a leading importer, are ordinarily thought of as the major benefits man derives from the coconut palm. It is, however, a versatile tree. The trunk yields a timber (identified in European commerce as porcupine wood); its heart, an ingredient of a salad; its bud, a vegetable (palm cabbage); its flower, a toddy; its leaf, material for fans and baskets. From the husk of its fruit, or nut, comes coir fiber for matting and cordage; from the shell, a charcoal; while the kernel, if shredded, finds its way into cakes and pies, providing it escapes its more common destiny of being dried to make copra. Copra is converted into coconut oil for soap and margarine manufacture, and into a residue, or "cake", which is an A-1 cattle food.

By way of the Philippines now comes a tale of *Cocos nucifera* put in competition with Guernsey cows and honey bees. Herbert Walker, one-time Supervising Sugar Technologist for the Sugar Centrals operated by the Philippine National Bank and, more recently, President of the Tropic Products Company of Manila, is responsible for this unique and paradoxical rivalry. His original inspiration came from sugar planters on the Island of Negros where hospitality includes the serving of an ancient Filipino delicacy, *Mata-mis-sa-bao*, meaning sweet in the shell. It is made by cooking the emulsion, or "cream," obtained by hand-pressing fresh coconut meat after adding native sugar. The commercial possibilities of this "friendship sweet" led Mr. Walker to experiment in making it, but his progress was slow because, on standing a few days, the fat separated from the syrup and the mess turned rancid.

Unexpectedly, however, these disappointing results induced him to consider another possible product. Neighboring children and houseboys, feeding on the "leftovers" of his experiments, were making astonishing gains in weight. Knowing that fresh coconuts contain the same food properties as cows' milk, he decided that by diluting the fresh emulsion with the natural water in the coconut (to reduce overrichness), a vegetable "milk" might be compounded. With fresh cows' milk selling at 50 cents a quart, owing to the shortage of dairy herds in the Philippines, it was obvious that a coconut milk retailing for ten cents a quart might be promoted.

So his coconut dairy came about and, by months of effort and education, the output of a completely modernized plant with a battery of hydraulic presses and electrically operated shredders finds a ready market. The emulsion, extracted at a pressure of 3,000 pounds from shredded and sterilized coconut meat, is mixed with pasteurized coconut water; the combination being cooled and bottled in a refrigerator to offset the effects of tropic temperatures. Coconuts are almost sterile until opened and this property, plus the extreme care taken during the manufacturing process, is responsible for a bacterial count that averages about 400 to 100 cc. The caloric value of the coconut milk per 100 cc. is 68.5 as against 69.0 for cows' milk.

Rittase

The march of power

A four-month test, conducted by the Philippine Public Welfare Commission on 80 children, showed: first, that those fed coconut milk as a supplementary diet made practically the same gain in weight as those receiving cows' milk; second, that the 80 showed a gain of 28% to 32% over a group who received no milk. This report definitely put to rest claims by some of the Filipino medical groups that children in the Philippines did not need milk inasmuch as Nature had not provided the Islands with cows.

It also reverted Mr. Walker's attention to the native sweet, which problem has now been conquered by perfecting the first fat, sugar and water emulsion that will remain in suspension and not turn rancid. The base of the product is the same used in making coconut milk, the so-called "cream," as it comes from the "dairy's" presses, being run into steam-jacket, copper kettles and mixed with invert sugars. After cooking, when fairly cool, the resultant is packed in glass jars for the retail trade under the brand "Mandalay." Since it has the viscosity and color of unstrained honey, though its uses exceed those of ordinary bees' honey, the appropriate popular name of "coco-hon-ee" is also applied. It goes well on waffles or hot cakes and, besides, is excellent for fountain use, giving to sodas, milk shakes, and ice cream, the delicate and hitherto elusive, flavor of fresh coconuts. For three additional products the manufacture is varied slightly to make a light paste, which looks like crushed pineapple and is a topping for puddings or ice cream, and heavy and dark pastes suitable for confectionery makers.

A suggestion for yachtsmen. This ancient mongrel packet was snapped on the Bosporus by James A. Patch, '00

Wasteful Weight

MODERN structures, both movable and stationary, are suffering from overweight no less than a large portion of the people who use them. Buildings groan under surplus layers of fat — in the main consisting of fire insulation — while obese trains, automobiles, and ships waddle along secure in their portliness but prodigal in their waste.

"The Empire State Building," states one of its architects, "weighs 365,000 tons and is built to house about 25,000 persons. This means that it takes more than 14 tons of building to support a man, rather a striking demonstration of the disproportion between the weight of a modern building and the load it is intended to carry."

Nowhere has this engineering and architectural ineptitude been so self-evident as in the design and construction of floors. Present methods involve the use of materials in floor panels which result in a dead load in excess of any live load to be supported. Column stresses for dead loads in a multiple-story building are often two-thirds of the total stress. Since the only reason for constructing a building is to provide support for a live load, it is unfortunate that builders must now dedicate so much to useless weight. New and lighter materials, as well as more extensive knowledge of the strength of present materials and construction methods, are urgently needed. Fortunately, a pleasing response is in evidence, and welding furnishes a spectacular example of what can be done. The battledeck steel floor, a child of the welding process, saves perhaps 25% in weight, and in the ingenious A. O. Smith Corporation Research Laboratory in Milwaukee, engineers have estimated that the dead load on each column is about 100,000 pounds less with battledeck floors than it would have been had a floor of steel joists and concrete slab construction been used. Stating it in another form, battledeck floors make it possible to increase the height of a building by one-quarter, without adding to the foundation load.

Advances such as this have pointed to a more extensive use of metal in buildings. The more intelligent and general use of metal is to be the hall mark of the new and better buildings, according to William F. Lamb, co-architect of the Empire State Building. "Some day we are going to be able to build our walls of metal, backed by insulating materials, and without the heavy masonry that loads down our steel skeletons." A metal apartment building, in fact, has already been designed for erection in Chicago. For a building of its height, the usual masonry walls are 14 inches thick and weigh 150 pounds per square foot. With insulation, the proposed metal walls are only one-quarter as thick and weigh only 12 pounds per square foot.

In addition to welding and the more general use of metals, many other new devices and techniques are being evolved. Steel joists, junior beams, built-up joists, and grid flat slabs have been devised for reducing the weight of floors. Aluminum, particularly in the form of its alloys, is being pushed as a structural material, and there are, of course, the aërated or expanded concretes, from 20% to 75% lighter than ordinary concrete and much more fire-resistant. Among these may be mentioned *porete*, *cinder concrete*, and *aerocrete*. In another category fall *haydite*, a light, heat-resistant aggregate, *gypsum*, and bricks of diatomaceous earth.

Rouse

The new and the old in German architecture: on the left, combination apartment house, store, and factory near Karlsruhe; on the right, the archers' gallery on the Rothenburg wall

An artificial pumice recently appeared on the German market. In the form of hollow blocks it is reported to be cheaper and lighter than brick.

In other fields than that of building construction, the fight against wasteful weight is being conducted. The Pullman Company is now building a sleeping car entirely of aluminum save for wheels, axles, brakes, and springs. It will be 25% to 40% lighter than comparable steel cars. Thirty-five aluminum electric cars already are in operation on the Indiana Railroad. In The Review last July, Mr. Othmar H. Ammann described how excess weight is being eliminated from suspension bridges by better design and the use of alloy steels. In the May issue, Mr. Harold E. Lobdell, '17, reported similar progress in locomotive design. In one vessel (S. S. *Carolinian*) welding saved one-fifth in weight and one-quarter in construction costs, besides adding 20,000 gallons to the cargo space.

The growing number of these lighter materials and weight-decreasing methods is evidence of an intelligent demand for less weight. By the time the physicist has given us a reasonably efficient electric light (present efficiency 5% to 10%), the engineers should have learned the art of reducing their structures to an economical but perfectly safe thinness.

The Last of the Schneider Cup

IN 1912 M. Jacques Schneider, son of a wealthy gun manufacturer, presented to the *Fédération Aéronautique Internationale* a trophy to be awarded to the winner of an annual seaplane race. In September of this year the trophy was retired by Great Britain, which had fulfilled the condition of winning it three times within five consecutive contests. The first contest, in 1913, was won at Monaco by a plane which attained a speed of 45.25 miles an hour. In 1925, at Baltimore, Major James H. Doolittle, '24, won for the United States with a speed of 232.57 miles per hour. This year's contest winner hurtled around the course at 379.05 miles an hour, and later achieved an international straightaway speed record of 408.8 miles an hour, more than half the speed of sound.

M. Schneider died in poverty in 1928, but if the donor of the trophy decreased in affluence during the intervening years, the financial resources demanded of competitors certainly traveled in the opposite direction. At first the goal of private sportsmen of moderate means, success in the contest soon became a mark of distinction for powerful manufacturers of aircraft and finally the fiercely sought prize in a contest between national governments, draining heavily on their technical facilities, flying personnel, and public treasuries. During the year of Schneider's death, for example, the combined governments of England, France, Italy, and America must have spent well over $5,000,000 in the hope of winning the trophy.

Possibly the attractiveness of the trophy itself, a group of statuary valued then at $5,000, and the money prize of the same value were important to the first competitors. Certainly at the end the nations in pursuit were after prestige of military services, national engineering reputations, and the design data on high-speed flight so necessary for military aircraft.

The table below shows the increases in speed and horse power of the Schneider trophy winners since their first race in 1913.

	Speed in miles/hour	Horse power		Speed in miles/hour	Horse power
1913	45.75	160	1925	232.57	515
1914	86.80	100	1926	246.49	800
1920	107.00	550	1927	281.65	875
1921	111.00	200	1929	328.63	1,800*
1922	145.70	450	1931	379.05	2,400*
1923	177.38	465			

* Exact horse power not made public.

A survey of the entire series is very interesting from a technical point of view. Since the record of 1923 the speed for seaplanes has been increasing more rapidly than for landplanes until now it stands almost 150 miles an hour above it. This seems at first an unnatural state of affairs due to an apparently greater air resistance caused by floats over that caused by a wheel landing gear. The reason lies in the fact that the required landing speed, between a third and a quarter of the top speed

realized, is much less dangerously negotiated on a surface of water than on an airport. The resistance of floats has also been found much less than was at first expected. Probably this year's Schneider winner, reëquipped as a land plane, would gain less than ten miles an hour by the change.

The same year, 1923 (marked by the entry of the American Navy, the first governmental participation), was also the first real advance in ultra-refinement of streamlining. It has been said by good authority that "today practically every aeroplane in the world which has a first-class speed performance conforms to the lines of those Curtiss racers of 1923."

Since that date progress has been largely through decrease of frontal area and increases of horse power of the engines, although the development of radiators built completely into the wing, with the smooth, metal, wing surface serving as the cooling area and the complete enclosing of the pilot in a transparent streamlined cowling, have also aided materially.

Remarkable engines have been built for these planes. Such is their refinement and complexity that the terrific loads placed on them usually render them valueless after a few hours' running. Although costing several hundreds of thousands of dollars, these power plants are usually expected to have a total useful life in the neighborhood of 12 or 15 hours and even so there are probably as many planes which have been forced out of the races of the last ten years by motor trouble as have been able to complete the course of 350 kilometers. No wonder hard pressed nations breathe easier at the retirement of the trophy.

The Reach Toward Exactness

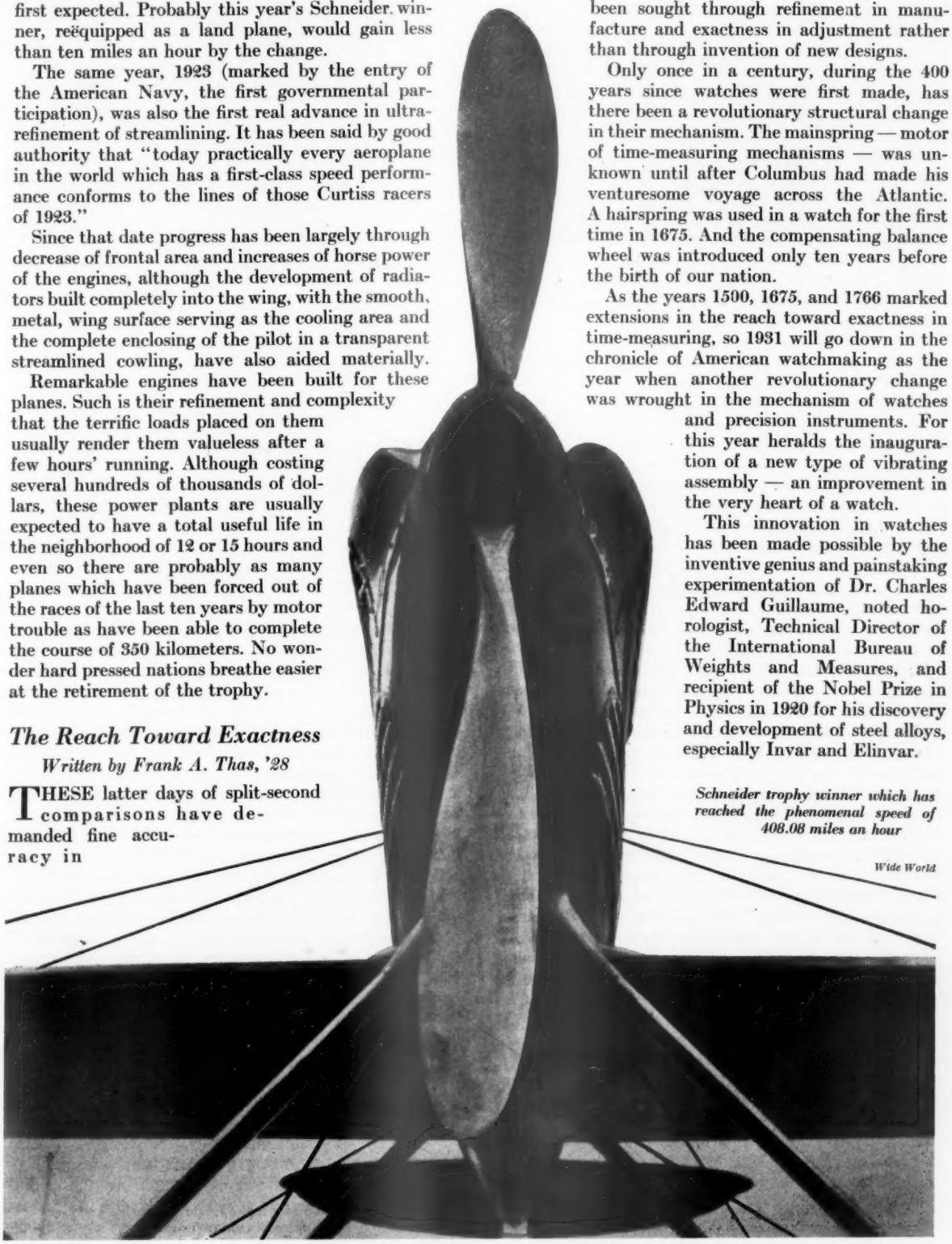
Written by Frank A. Thas, '28

THESE latter days of split-second comparisons have demanded fine accuracy in watches and precision instruments. Though this demand has been met to a remarkable degree, greater accuracy in timepieces has been sought through refinement in manufacture and exactness in adjustment rather than through invention of new designs.

Only once in a century, during the 400 years since watches were first made, has there been a revolutionary structural change in their mechanism. The mainspring — motor of time-measuring mechanisms — was unknown until after Columbus had made his venturesome voyage across the Atlantic. A hairspring was used in a watch for the first time in 1675. And the compensating balance wheel was introduced only ten years before the birth of our nation.

As the years 1500, 1675, and 1766 marked extensions in the reach toward exactness in time-measuring, so 1931 will go down in the chronicle of American watchmaking as the year when another revolutionary change was wrought in the mechanism of watches and precision instruments. For this year heralds the inauguration of a new type of vibrating assembly — an improvement in the very heart of a watch.

This innovation in watches has been made possible by the inventive genius and painstaking experimentation of Dr. Charles Edward Guillaume, noted horologist, Technical Director of the International Bureau of Weights and Measures, and recipient of the Nobel Prize in Physics in 1920 for his discovery and development of steel alloys, especially Invar and Elinvar.



Schneider trophy winner which has reached the phenomenal speed of 408.08 miles an hour

Wide World

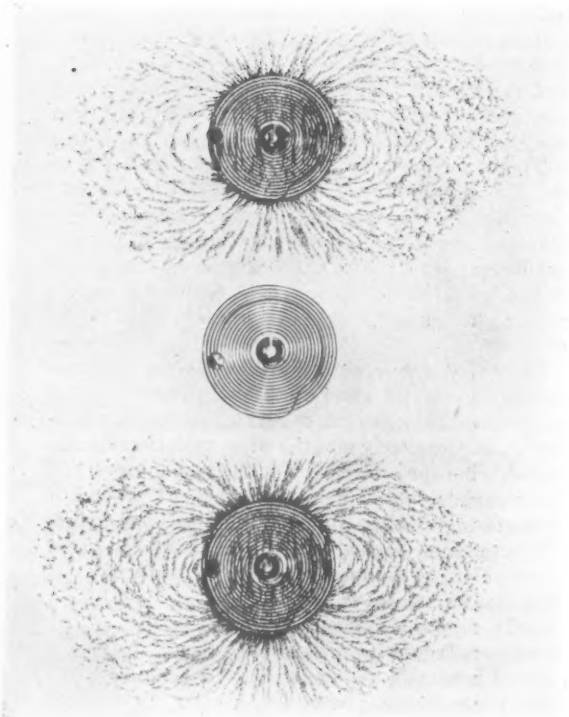
The latter alloy, Elinvar, is the basic factor in the present improvement in the vibrating assembly of a watch. It has made possible the production of a hairspring for watches and precision instruments which: (1) is almost immune to magnetism; (2) recovers normal status immediately upon removal from a magnetic field of even 3,600 lines; (3) does not lose elasticity in high temperatures; (4) permits (because of these and other characteristics) the use of a monometallic, non-magnetic, solid balance wheel.

From this it will be seen that not only accuracy but also simplification has been attained as a result of Dr. Guillaume's labors in the perfection of alloys for specific purposes. The benefits of his invention of Elinvar have been made available to the people of the United States by the research staff of the Hamilton Watch Company, Lancaster, Pa. Elinvar is a nickel steel alloy containing small quantities of chromium, carbon, tungsten, and manganese.

Prior to Dr. Guillaume's invention of this alloy it was necessary to provide a compensating device to neutralize error caused by variation in the elasticity of the conventional steel hairspring due to changes in temperature. Hairsprings, heretofore necessarily used, become weaker in higher temperatures and stronger when cooled. Hence they would cause a watch to run slow or fast, according to temperature changes, unless this unavoidable error were in some way compensated.

This difficulty led to the invention of the compensating balance wheel by Pierre LeRoy in 1766. In its present form, after successive improvements over LeRoy's original conception, the compensating balance wheel consists virtually of two bimetallic strips of semi-circular form, each extending in an opposite arc from respective ends of a single "spoke" — the balance arm. Or it might be described as a bimetallic wheel with brass-and-steel rim cut at two points, one on each side of, and near to, the ends of the cross arm.

Heat, which reduces the elasticity of the ordinary steel hairspring and would, if uncompensated, cause the watch to run slow, tends to move a portion of the weight of the split balance wheel toward the center of oscillation by drawing inwardly the free ends of the two sections of the bimetallic rim, thus increasing the speed of oscillation and overcoming the error caused by the weakening of the hairspring. In practice it has been found that it is possible to adjust the balance to compensate exactly at only two temperatures and that exact compensation is not obtainable between or beyond these two extremes. A hairspring made of Elinvar, being practically unaffected by temperature changes, requires

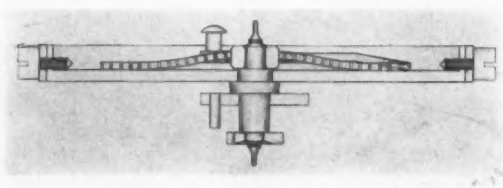


Conventional steel watch hairspring (top and bottom) showing attraction for steel filings; Elinvar hairspring at center. All three have been subjected to the same magnetic field

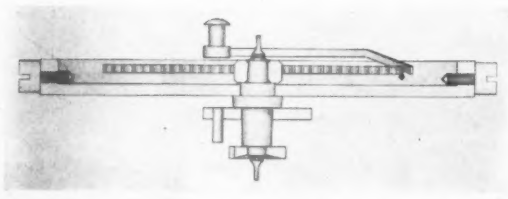
no complex compensating device and permits the use of a solid rim, monometallic balance wheel. Further, the balance wheel can be of non-magnetic material and it is this combination of a non-magnetic balance wheel with a hairspring that cannot be permanently magnetized which makes a watch thus equipped so nearly immune to magnetism that for all practical purposes it may be said to be anti-magnetic.

Exhaustive tests were made in the Hamilton laboratories of 20 railroad watches — ten with bimetallic, cut balances and steel hairsprings and ten with Elinvar hairsprings and solid, monometallic balance wheels.

These 20 timepieces were first put through tests, each of two days' duration, in five different positions — vertical pendant up; vertical pendant right; vertical pendant left; horizontal dial down; and horizontal dial up — all in a temperature of 68° F. In the dial-up position they were then tested at 41° and at 95°. Finally



Cross section of watch balance with ordinary steel hairspring and bimetallic balance wheel, showing effect of magnetization



Cross section of balance with Elinvar hairspring and monometallic balance wheel

they were again put through a second test in the pendant-up position for two days in a temperature of 68° (same as at the start) to determine how closely they repeated their performance after the previous tests which had occupied a period of two weeks. Again these 20 watches (ten of each type) were put through the same paces after having been subjected to direct current magnetic fields of 36, 360, and 3,600 lines per square inch respectively.

Before being magnetized, the watches in both groups showed practically the same error due to temperature changes. But at some point between a magnetizing field of 36 lines and 360 lines, the watches having conventional balances and steel hairsprings were sufficiently magnetized to be rendered useless as timekeepers. Those equipped with Elinvar hairsprings and non-magnetic, monometallic balances were not noticeably affected. Even after exposure to a magnetic field of 3,600 lines, these Elinvar watches resumed running and were still good timekeepers. The bimetallic watches stopped after being magnetized in a field of this strength.

It was noticed that a watch with monometallic balance and Elinvar hairspring (regulated to give perfect time before magnetizing) showed a loss of approximately six seconds a day after having been magnetized in a field of 3,600 lines. This loss was regular and the variation in daily rate by temperature changes and positions paralleled the original rate.

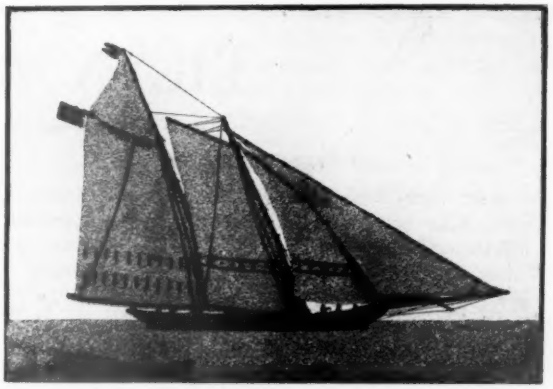
It has been several years since Dr. Guillaume made his notable discovery of the alloys mentioned above, yet we are just beginning to take full advantage of their possible uses. It is gratifying to note that well-organized research laboratories of today are constantly on the *qui vive* to reduce this lag between a scientific discovery and its practical application.

Giant Spectroscope

ALTHOUGH Technology's new spectroscopic laboratory is not yet completed, the Institute is carrying on important researches in spectroscopy, particularly in the intensity of spectral lines. As an indication of what may be expected in the future, Dr. George R. Harrison, Director of the Research Laboratory of Experimental Physics, has developed an unusually large vacuum spectroscope. In this instrument, which consists of a 21-foot cylinder, it has been found possible to obtain a vacuum of less than one part of air in ten million. This high vacuum is accomplished by eight pumps, and the final step in exhaustion is obtained by boiling mercury.

In this large spectroscope studies are being carried on in the wave lengths of light in the very short ultra-violet region of the spectrum to learn more of the movements of electrons in the atom. The source of light for these experiments is an electrical discharge of approximately 30,000 volts between points composed of the element whose atoms are under investigation. Among these elements are vanadium and titanium.

The light beam strikes a grating containing 90,000 diamond-ruled lines of which there are 15,000 to an inch, and is reflected to a photographic plate upon which a record of the spectrum is made.



From a picture drawn with sand of the schooner yacht, America, *erstwhile winner for America against Great Britain. The original of this curious print, dated 1851, is in the possession of Professor Charles H. Porter, '02*

Alcoholic Cement

BY WAY of rendering autumnal homage to Clio, we have been delving a bit into the life history of mortar and cements. At first glance the subject would seem forbiddingly dry, but our arduous researches have fetched up a few choice plums that bear passing along.

The Babylonians, it seems, were unacquainted with mortar and they used instead asphalt to join their stones. Excavations at the ruins of Nineveh and Babylon have proved that the stones joined by asphalt remained fixed together through thousands of years, though somehow we can imagine that Babylonian buildings oozed and crawled a little on hot summer afternoons.

The Egyptians used gypsum mortars; the Greeks and Romans, lime. There is a story, doubtless apocryphal, that some of the wonderfully hard Roman mortar was made with wine instead of water and that even white sugar, common salt, and other substances were additional ingredients.

The best story, though, comes from Russia, and it is authentic. It concerns the building of the Alexander Column in Leningrad, an engineering job of some magnitude. In the base of this column is a huge stone weighing about 400 tons. Naturally, difficulties were encountered in pushing this stone about, with the result that the foundation upon which it was to be moved was covered with a layer of a very peculiar mixture. "As the whole work had to be carried out in winter," stated the builder of the column, the architect, Montferrand, "I ordered the cement to be mixed with vodka, and added a quantity of soap equal to a tenth part of the whole mixture. Since the stone was not placed correctly at first, it had to be moved several times on the foundation. Only two capstans were used for this work, which was accomplished with the greatest ease, owing, of course, to the soap that I had added to the mixture." This story, we might add, is garnered from a recent communication from the Director of the Bureau for the Preservation of Monuments of Art and Antiquity of the Commissariat for Education of the Union of Socialist Soviet Republics. That sounds official enough!

TRANSATLANTIC

EDITORIAL NOTE

In order that Review readers may receive first-hand information about foreign scientific and engineering affairs, two Technology professors, this year traveling and studying in Europe, have been commissioned to record their impressions in the form of monthly letters. The first of these are presented below; one by Dr. Norbert Wiener, and another by Dr. Tenney Davis, both well known to readers of this magazine.

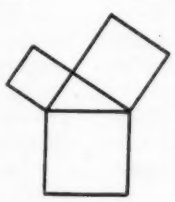
Education and Science in England

YOUR correspondent, now that he has a semi-permanent roof over his head, and can look about him, wishes to give you the benefit of his observations and reflections in scientific places. First, Cambridge University — the original Cambridge — has changed very little in 18 years, at least as far as externals go. A few new college buildings, a modern block or two on Sidney Street, and a rather extensive building-up of the more remote environs of the town, are all that meet the eye. Of course, the personnel has undergone extensive gains and losses — MacTaggart is dead, Russell is lost to Cambridge, Hobson is retired; and on the other hand, those whom your correspondent remembers as lecturers in the early stages of their academic careers are carrying on the spirit of the place as professors, which connotes a much more restricted sub-class of the teaching staff than does the same term with us.

Life at Cambridge

For all this going and coming of individuals, the milieu is much the same as ever. There is the same tolerance of individual peculiarities, the same intensity of devotion to learning, the same somewhat monastically sheltered life. There may perhaps be a shade less of aristocratic coloring to the environment — the war has had the same consequences everywhere — but this coloring had already abated much before 1913. One is left with the impression that the quasi-English academic life, which our friends at Harvard Square are trying to introduce, represents an archaic tradition which is substantially obsolete over here, and that the English University, for all its adherence to ancient forms, is far more akin to our own free and easy scholarly contacts than to the Harvard Houses.

I dined as a guest in Hall at Trinity the other day — we did *not* dress for dinner — and found the gathering as informal as, and the meal far better than, any of our noontime lunches about the Table Round in the Faculty Room at M. I. T. They wear the garment of medieval form as they wear their own academic gowns — loose and comfortable — and do not parade it with the self-conscious ostentation of the parvenu.



I find English academic life most delightful, in England, but it is an article which will not bear sea transport.

The Trend in Physics

Among the gossip at table the other night, I heard that Bragg expects modern physics to assume a permanent form in some four years. Myself, I am rather skeptical, as almost the simplest of physical problems have not yet received even a satisfactory formulation. Ever since physics went off the gold standard in 1925, we have been going through a period of inflation and wild speculation, and if we want to bring this to a close, we shall have to junk the lion's share of our paper profits and be content with a paltry 30 cents on the dollar or something short of that.

I heard great praise of Hille's recent work at Princeton. In general, one curious criticism of American work in mathematics was that our men were too dead serious, and did not seem to be getting enough fun out of the game. They appear to regard analysis as a place where we are particularly weak, although this is perhaps due to the fact that the people to whom I was speaking are members of one of the strongest schools of analysis in the world — that of Hardy and Littlewood. Outside of this school, much of British mathematics seems to the American to be rather special, both in problem and in technique.

B. A. A. S. Meeting

I was at the meeting in London of the British Association for the Advancement of Science. This seemed to bear a close family resemblance to meetings of the American Association — the same rush and confusion of registration, the same sententious general lectures.

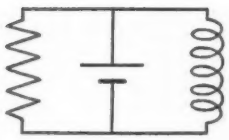
The physics section put on a good show. R. W. Wood of Johns Hopkins spoke on one of the big days, with Niels Bohr, Knudsen, Aston, and others. He can present a lecture experiment in a most fascinating way. The following day was given to sundry predictions by Jeans and Eddington of the ultimate disruption of the universe by the De Sitter expansion, and to lamentations as to the decreased time-scale thus yielded.

The physicists of the world had a long two weeks of it. The Faraday celebration and the meeting of the British Association were followed here at Cambridge by a Clerk-Maxwell celebration with papers both personal and scientific by Sir J. J. Thomson, Jeans, Planck, Bohr, and others.

Through the courtesy of Commander Appleyard, I have examined superficially the Oliver Heaviside correspondence at the Institute of Electrical Engineers. It is a marvelous collection. I learned that the Preece-Heaviside controversy, which cost Heaviside so much during his lifetime and Preece so much in what concerns his permanent reputation, was not purely

scientific in origin, but dated back to their youth together at the Great Northern Telegraph Company's cable station at Newcastle. I shall discuss this Heaviside material more fully in a future letter.

NORBERT WIENER



The Faraday Celebrations

ON AUGUST 9, 1831, Michael Faraday discovered the principle of electromagnetic induction, the principle which makes possible the long-distance transmission of power and the production of the high frequencies which are used in radio — to mention only two of its important applications. This discovery and Faraday's other discoveries in electricity, in particular that which led to machines for producing electricity from motion, have altered the whole face of our civilization. Among the things which we have and use and do which our grandfathers didn't, there is scarcely one which does not involve a principle which was discovered by Michael Faraday.

Joseph Henry of the Smithsonian Institution probably discovered electromagnetic induction before Faraday, but he delayed in the publication of his observation. Neither Henry nor Faraday would probably have made the discovery except for the earlier discoveries of Ampère, Arago, and Oersted. It was known that a wire carrying a current causes movement in a magnetic needle, and, conversely, that a magnet causes movement in a conductor carrying a current. It was known that wires carrying current produce motion in one another. There existed some sort of relationship between electricity and magnetism and motion. A bar of iron lying within a coil of wire became magnetized if a current of electricity was passed through the coil. But a magnet lying within a coil of wire did not set up a continuous current in the coil. Faraday discovered, however, that the motion of the magnet in and out of the coil produced momentary currents. In his classic experiment, Faraday wound two coils on a ring of soft iron and found that a momentary current was produced in one of them when an electric circuit was made or broken through the other.

In celebration of Faraday's discovery, the Royal Institution of Great Britain entertained guests and delegates during the week of September 21. More than 200 delegates attended from the leading universities and academies of the whole world. The Institute of Electrical Engineers met in London at the same time and opened in the Albert Hall an Electrical Exposition in which Faraday's apparatus was shown and his experiments and those of others were demonstrated, and their later applications and developments exhibited. The principal public buildings of London were flood-lighted at night. Many of the speeches were broadcast, among them, Sir William Bragg's lucid account of the simple and fundamental experiments of Faraday. Portraits of Faraday were exhibited in the shops. Posters of Faraday were on display in the subways, on busses, and on billboards. The London *Times* published a supplement, fully illustrated, and containing articles on Faraday, his discoveries, and the consequences of his discoveries.

On Monday afternoon the delegates met in the amphitheater of the Royal Institution, the same room where Faraday lectured, the same lecture table in front of them, and were there received by the officers of the Society. Eleven new foreign honorary members were named; among them, four Americans, Howard McClenahan, Michael Pupin, Elihu Thomson, and R. W. Wood. In the evening at a commemorative meeting in Queen's Hall, we heard speeches, which were also broadcast, by Ramsay MacDonald; Sir William Bragg, the Marquis Marconi; and Professors Elihu Thomson, Zeeman, and Debye. On Tuesday and Wednesday the Royal Institution arranged trips around London, to Windsor Castle, and so on, for the delegates and guests. Sir William Bragg several times repeated his fascinating lecture on Faraday's discoveries, speaking at the same table where Faraday used to speak and demonstrating the experiments in part with the same apparatus.

Tuesday evening there was a formal reception to delegates and guests at the Royal Institution, and historic apparatus of Faraday, Davy, Rumford, Dewar, and Rayleigh was exhibited in the ambulatory, back of the amphitheater, as well as personal mementos of Faraday, the Bible which he bound himself and used and annotated, decorations which he received, pieces of jewelry which he gave to his wife, and the little box-wood model, representing the lines of force around a conductor, which he habitually carried in his pocket and held in his hand while lecturing.

Wednesday, the Exposition at Queen's Hall opened. Faraday's diaries were exhibited and his electrical and chemical apparatus was on view, the apparatus which he used in discovering the laws of electrolysis, and a sample of the original benzene sealed up in a small glass tube.

On Thursday afternoon, the delegates were the guests at a garden party at Busby House and were given an opportunity to visit the National Physical Laboratory. A reception in the evening in the rooms of the Royal Society provided another opportunity for conversation with men of science from everywhere, but an opportunity which would have been embraced more readily if so many epoch-making objects of the history of science had not been exposed for examination. Faraday's diary and commonplace book lay open on the table and could be handled. There was Hawksbee's air pump, Cavendish's balance, Priestley's electrical machine, a collection of radiometers which belonged to Crookes. There were manuscripts of Newton, Boyle, Hooke, and others, and everywhere paintings of men whose names are chapter headings in the history of science. On Friday evening His Majesty's Government entertained the delegates with a dinner at the new Dorchester Hotel, a fine dinner, a dinner impossibly fine to an Eighteenth Amendment, Twentieth Century, American hotel. There were speeches by the Marquis of Reading, who presided, by Sir Robert Robertson, and by Professors McClenahan and Sem Saeland, all in praise of Faraday and, in the case of the last two speakers, in praise of British hospitality as well.

TENNEY L. DAVIS

THE DEATH OF CHAIRMAN STRATTON

His Notable Career and the Tributes Paid to Him

FOR the fourth time in its history, the Institute of Technology is called upon to mourn the loss of a leader removed by death, suddenly and in the fullness of his powers. Rogers, Walker, and Maclaurin died in the midst of their great labors and now Samuel Wesley Stratton joins that illustrious group. On Sunday night, October 18, at 7:30, he died almost instantly as a result of coronary occlusion.

Death came dramatically. He was dictating a tribute to his friend and contemporary, Thomas A. Edison, who had died that morning. In the midst of a sentence bearing tribute to Mr. Edison, Dr. Stratton slumped over. Only a week before, he had returned from a trip to England where he attended the Faraday Centennial celebration. To his friends and associates he seemed extraordinarily well and happy after this trip and a very pleasant summer. On his 70th birthday, July 18 last, he was presented with a huge portfolio of congratulatory letters from friends all over the world. And it was in the exuberance of that birthday celebration that he was led to declare that he had enough work scheduled to keep him busy until he reached 100.

His funeral was held at Trinity Church, Boston, at 2:30, Wednesday, October 21. The officiating clergymen were the Reverend Arthur L. Kinsolving, Rector of Trinity Church; and Dr. Stratton's intimate friend, the Reverend J. S. Moses, Rector of the Church of the Redeemer, of Brookline, and Bishop William Lawrence.

The honorary pall-bearers at the funeral were: F. R. Hart, '89, C. T. Main, '76, Everett Morss, '85, Gerard Swope, '95, Elihu Thomson, E. S. Webster, '88, and President Compton, all of whom are members of the Executive Committee of the Corporation of Technology; J. E. Aldred, F. W. Fabyan, '93, W. S. Forbes, '93, J. R. Freeman, '76, President A. Lawrence Lowell of Harvard University, C. A. Stone, '88, all members of the Corporation; Capt. W. S. Anderson, U. S. N., G. K. Burgess, '96, Director of the Bureau of Standards; Bradley Dewey, '09, President of the Alumni Association; Professors J. R. Jack, S. C. Prescott, '94, and F. S. Woods, Chairman of the Faculty; DeW. C. DeWolf, representing Governor Ely; General Allston Hamilton, War Department; and Admiral L. M. Nulton, U. S. N.

FROM THE PRESIDENT OF THE ALUMNI ASSOCIATION

Dr. Stratton's loss is a great blow to all of us. He came to Technology from a great institution of his own founding and soon taught us of his worth and his whole-hearted loyalty to Technology. At a difficult post-war time, when science and industry were forging ahead together and the problems of technical education were multiplied, he brought to his work a wonderful ability as a promoter of research. He tided Technology over a most difficult period and will be remembered by all of us as a man who was fearlessly outspoken but at the same time fair and ever helpful to those about him.

BRADLEY DEWEY, '09

Twelve prominent undergraduates were active pall-bearers. They were: D. B. Gilman, '32, President of the Senior Class; C. M. Chase, '32, General Manager of *T. E. N.;* T. B. Rhines, '32, President of the Athletic Association; H. D. Humphreys, '34, President of the Sophomore Class; R. G. McKay, '33, President of the Junior Class; L. P. Leino, '32, Chairman of the Dormitory Committee; F. M. Moss, '32, President of the Architectural Student Council; R. R. Hall, '33, President of the Technology Christian Association; W. H. Barker, '32, Business Manager of *The Tech,* C. M. Thayer, '32, General Manager of *The Tech,* J. E. Harper, Jr., '32, General Manager of *Voo Doo,* and T. R. Heim, '32, General Manager of *Technique.*

The Memorial Meeting at the Institute

AT TWELVE o'clock preceding the funeral, the entire staff of the Institute convened in Room 10-250 to hear memorials presented by President Compton and Professor S. C. Prescott, '94. Professor F. S. Woods presided as Chairman of the Faculty.

PRESIDENT COMPTON'S TRIBUTE

DR. COMPTON spoke as follows:

"This occasion brings vividly to my mind, by contrast, an occasion at which most of you were present, about 18 months ago in this room, when Dr. Stratton introduced me to you as his new colleague. Little did we then think that I would, in this same spot, so soon reply to his welcome of me by expressing my farewell to him. Throughout this brief interval he has encouraged me, advised me, given me support and freedom of action, yet without violating his own unflinching sense of what should be done. I wish to bear tribute to his greatness and fundamental kindness of character.

"At such a time as this we all want to pay tribute to Dr. Stratton as a personal friend and colleague. It is, however, particularly appropriate that I should take this opportunity to review those distinguishing traits of character and those ideals which are his real personality and which will continue to live, for by keeping in mind these things we can best progress in the directions in which he would have led us had his life and vigor been spared. I should like, therefore, briefly to mention three of Dr. Stratton's characteristics which have seemed to me most to distinguish him.

"As the first characteristic I would call attention to Dr. Stratton's unassuming and generous spirit. Before I knew him intimately, I knew of this characteristic through my many friends who were among the younger members of the staff of the Bureau of Standards. They told me of the great personal interest which he took in their work, of his help and frequently major collaboration, yet of his refusal to take any personal credit for the results achieved or to allow his name to appear on the

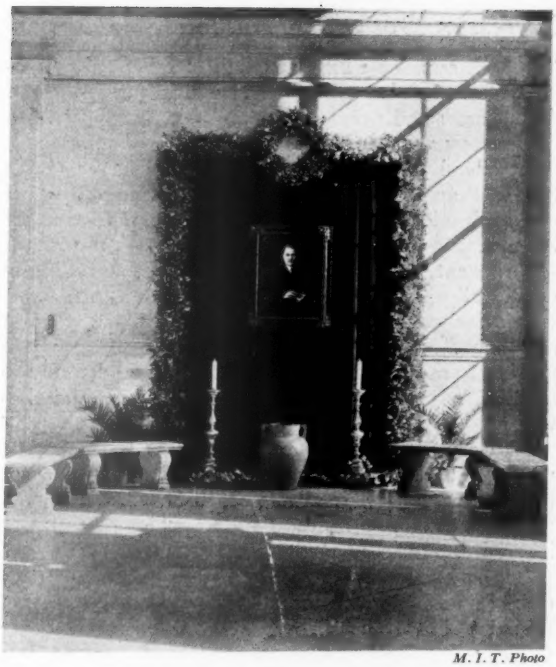
published reports. He had only two objectives, to get the results and to give the younger men every possible opportunity and encouragement. Once last year he told me a bit of his early experience which may, in part, explain this attitude.

"Early in his career as a physicist he had collaborated (and done most of the work) on an experiment that attracted world-wide attention. The work was announced and published under the senior collaborator's name, without mention of the younger man. Though Dr. Stratton has continued to love and admire that senior collaborator, this circumstance hurt him so deeply that he vowed to himself that he would never, in all his life, allow himself even to come under a suspicion of claiming credit for anything which might in any way be attributable to another.

"The second characteristic which has impressed me has been Dr. Stratton's complete absorption in his work and plans. In one sense we may say that he was single-minded. This does not mean that he was narrow-minded, because this is far from the case. But all his interests were closely tied together in his main objective, which was the better development and utilization of science in the service of man, particularly in industry. For example, he was a connoisseur and collector of rare china, but this was but one aspect of his interest and activity in improving the ceramic art. He was similarly fond of rare and exquisite tapestries, but this again was associated with his work in bringing science to the aid of the textile industry. He was an enthusiast over tools of precision and frequently found his recreation in his workshop. But this was because he saw in tools an important agency for making scientific discoveries.

"One of his two conversations with me since his return last week from England also illustrates this point. It had to do with the customs and organization of the English universities. He was particularly interested in the differences between their and our customs and organization, but it was very evident that he was thinking about these and weighing them as to their advantage or disadvantage with respect to the objectives of service by science to industry.

"His second conversation illustrates the third and last characteristic which has impressed me more than all the others: the consistency of his life and thought. He had a definite ideal and objective. Everything in his life was valued as good or bad according as it led toward or away from this ideal. He was perhaps unsympathetic, and certainly impatient, with things or people whose influence ran contrary to his ideal. Anything which blocked the path toward the ideal irritated him, just as anything which led toward it received his full support. All this was essentially impersonal. It was the only consistent reaction of a mind so devoted and absorbed in working for the great ideal in which he wholeheartedly believed that no conflicting or ambiguous attitude seemed possible or worthy of defense. In this second conversation to which I referred, he discussed the establishment and strengthening of certain lines of study and research, whose treatment is complicated by lack of precedent or personnel. He had seen striking evidences of the importance and success of this line of work in certain foreign countries and insisted that we must not let our precedents, regulations, or limitations of any sort stand in the way of making a rapid and important advance in these directions.



M. I. T. Photo

Portrait of Dr. Stratton by Sir Philip de Laszlo as it was hung in the Lobby of the Institute after his death. This portrait, by the famous artist, was Dr. Stratton's favorite

"In all this, gentlemen, we have a picture of a remarkable character. I doubt if any of us has ever known a man whose whole life has been so consistent, straightforward, and unswerving in its devotion to a particular form of public service and which has been carried on with such a complete elimination of self-interest. We mark today the passing of a great man. At the same time we recognize the lasting importance of those things which were the mainspring of his life, and we are happy that our position as his colleagues gives us the opportunity to 'carry on.'

"In conclusion I want to add this very brief personal tribute. Having always respected and admired Dr. Stratton for his accomplishments and because of what I knew to be the feelings toward him on the part of his colleagues, I have come, during the past year and a half of close acquaintance, to love him, almost as a father. I have had the opportunity to go behind his reserve and make some contact with his rich and affectionate spirit which to know was to love."

FROM THE CHAIRMAN OF THE FACULTY

It is with profound grief, and a sense of personal loss, that we of the faculty learn of the death of Dr. Stratton. He leaves a proud record as scientist and administrator. In particular, under his guidance as President, the Institute has taken many a forward step, the effect of which will be lasting. His wisdom and council will be greatly missed in Institute affairs.

F. S. WOODS

Professor Prescott's Tribute

"THE occasion which brings us together today is indeed a sad one, a time in which our feelings of deep sorrow and personal loss and our sense of loss to Technology are closely interwoven. A great man and a great friend has been taken from us. This is not the time nor an appropriate occasion to attempt to give any evaluation of what Dr. Stratton's remarkable life has meant to the sciences of which he was so conspicuous an exponent, or to the Institute which he so faithfully and loyally served. We are still too near to the event which has wounded us so grievously, still too stricken and benumbed by the suddenness and shock of his passing from his wonted place among us, to be able to speak calmly of his many useful services here and elsewhere.

"We can only, with faltering words and heavy hearts, pay tribute to his great character as a man, to his loyalty and steadfastness as a friend, to his intense devotion to the school he loved and for which he zealously labored, and to his constant efforts to help his fellow men.

"It is impossible to speak of him here without a deeply personal note, and I know that because of similar association on the part of many of you, my colleagues, you will pardon any references to my own experiences as I try in my poor way to do honor to one who has greatly lived, and whom we have greatly loved and respected. Like an inrushing tide, the waves of memory flood into our minds today. We recall those warm, friendly attributes, the breadth of his interests and knowledge, and that integrity of leadership which promoted the happy personal relations with him which all of us, in greater or less degree, have enjoyed in the years since he came to us in an official capacity.

"We cannot think of him now merely as a high official, for that implies a position of dictation and command, and a separation and aloofness which actually never existed. No man was ever more truly a colleague and co-worker, an elder brother and generous-hearted friend. And no man ever played the game of life, either as private or official, with its manifold human relations, more cleanly, fairly or straightforwardly than he.

"It happens to have been my good fortune to be closely associated with Dr. Stratton throughout almost the whole of his life at the Institute. I shall never forget the first time I saw him, when across a reception room and before I had ever spoken to him, I noted his kindly but searching blue-gray eyes, his illuminating smile, and the firm set of his head. Instantly, I inwardly felt that here was a friendly and sincere man of sterling character, wise but not hasty in judgment, and fine and generous impulses — a man, in our New England country phrase, 'who was safe to tie to.' Later, in the relations of a newly appointed department head, needing counsel and advice, and still more during three years as the spokesman for the Alumni Association, and then as Chairman of this Faculty, and of some of its special committees, I was privileged to have frequent and intimate contact with him. Perhaps the similarity of our boyhood experiences gave us, at the outset, a common basis of understanding and sympathy and opened the way to a deeper personal relation, and what I may call mutual spiritual response. Perhaps it was an unexpressed faith in each other, and tacit recognition of that nameless something that draws a man to his chief, or men to each other in relation closer than blood kinship. Of this I cannot say, but I found in him comradeship untainted by favoritism, loyalty which could withstand differences of opinion, a friendship steadfast, sincere, and sure.

"Those who knew him well early discovered that in him there were depths of feeling which were not plumbed by the casual acquaintance — a broad and vital human sympathy, a keen but kindly humor, and a deep dislike of sham and ostentation.

"There was an innate shyness in his nature which was sometimes falsely interpreted as indifference by those who did not look beneath the thin veneer of natural reserve. Once this slight barrier was broken through, the warm, gracious, generous nature of the man became apparent. No one could have close association with him without finding that besides being a prodigious worker, he had a responsive heart, a high sense of honor and character, a mind that could vigorously disagree without rancor, and a spirit deeply imbued with loyalty to the cause he espoused. It was these qualities of heart and brain — the very humanness of the man — that made him so idolized by those, old or young, who had had the privilege of working side by side with him and sharing in his industry, his hopes and achievements, and his projects for greater things.

"Few of us, if any, can ever know fully how greatly he loved young men, nor how many of them, whether among our own students or elsewhere, he aided by his fatherly counsel and by his efforts, often in hidden yet effective ways, for their welfare and happiness. In these ministrations as in other matters, his extreme modesty and dislike of anything savoring of personal publicity prevented any widespread knowledge of his many generous actions.

FROM THE STUDENT BODY

The undergraduates of the Massachusetts Institute of Technology have suffered an irreparable loss in the death of their esteemed Chairman and former President, Dr. Samuel Wesley Stratton. During his entire career at the Institute he showed an unflagging interest in the affairs of the student body, and his official responsibilities were never too heavy nor the business of his office too pressing to prevent him from receiving any one of us who sought his help, advice, or counsel.

It was his custom each year to entertain in his home our student governing body, the Institute Committee, as well as the entire freshman class, the occupants of the dormitories, the foreign student group, and many other organizations. Indeed, few students were denied the opportunity of meeting him informally.

Because of his enthusiastic support and sympathetic coöperation, our undergraduate activities prospered under his régime as never before, and our extra-curricular life was deeply enriched. In his official capacity as President of the Institute, he acted as friend and counselor of the undergraduate body in a manner that commanded the admiration and won the hearts of all those who came in contact with him.

I speak for the entire student body in expressing the sorrow that prevails throughout our ranks.

DONALD GILMAN, '31
President, Institute Committee

"The same diffidence, modesty, and almost self-depreciation, made it difficult for him to speak publicly with the effectiveness which characterized less formal expression of his ideas in conversation or in small group conferences.

"It is almost three years to a day, October 17, 1928, since in this room and before this Faculty he received the award of the Cross of the Legion of Honor of France for distinguished service. With characteristic modesty he dreaded the event, as he did all public functions in his own behalf, lest it should seem that he thought too highly of his fitness for the honor. On that day he received, from one who was not present, the following lines of tribute, which perhaps characterize some of those qualities which endeared him to us.

LINES TO SAMUEL W. STRATTON

On receiving the Cross of the Legion of Honor, October 17, 1928

Wise Knight of Science, France has our regard
That, in the full tide of your great career,
You should receive the Cross and accolade
Amid the plaudits of your *confrères* here.

So modestly you bear the bays you earn,
So simply take the praises of your name,
I half suspect you felt surprise to learn
That on your breast this Cross should blaze your fame.

I wonder if the dreams, the boyhood thought,
Of fame or greatness that *might be* your own,
Visioned such heights as Life itself has brought,
Or half the Triumph you have really known.

Yet in those days of fearless sturdy youth
Were somehow laid foundations strong and sure;
The consecration to the search for Truth,
The zeal that made this triumph so secure.

Triumph that came from patient labors wrought
Unmindful of reward or shouted praise;
The rich fruition of long nights of thought,
Of failures conquered, and of tireless days.

Triumph without sharp competition's hate,
Or ruthless use of lesser men for gain,
Rather by helping them to high estate
Your own was lifted to this loftier plane.

Proudly we know this honor nobly won,
Symbol of dauntless faith through gain or loss,
Of high emprise and human service done.
The Cross adorns you — You adorn the Cross.

"Now he is gone from us — whether in far realms of space his great steadfast spirit finds new spheres of useful service, or whether here in this room his unseen presence urges us today to carry on the great work he loved and in which we all were proud to share, we cannot know. This we know, that while life shall last and human affection and honor for noble and manly character shall survive in us, we shall hold him in deep and loving remembrance as a great servant of his people, a great leader and a great friend. What more fitting epitaph could be his than the last complete sentence to fall from his lips, as he spoke of another, 'His life and his accomplishments have been, and will be for many generations to come, the inspiration of youth.'"

Dr. Stratton at his desk. After his funeral, the body lay in state at Trinity Church, and for hours people filed by to see him for the last time. Chief among the floral designs was a laurel wreath sent by President Hoover, long a friend of Dr. Stratton

A Sketch of His Life

DR. STRATTON was born at Litchfield, Ill., on July 18, 1861, the son of Samuel and Mary B. (Webster) Stratton. His boyhood was spent on his father's farm and he early showed a keen interest in mechanical devices. It was his delight to investigate the various farm machines in an attempt to find out how they worked. This great interest in machinery and a natural aptitude for practical application of what he learned by his own youthful experiments awakened in him the desire for a technical education. He took full advantage of his school days in the country and then entered the University of Illinois. The time he could spare from his studies was spent in earning money to enable him to carry on his education, and in 1884 he was awarded the degree of bachelor of science in mechanical engineering.

His early years in the healthful life of a farm gave Dr. Stratton a rugged constitution. He was a tireless worker, and was particularly happy when he found time to

retire to his private laboratory for scientific investigations. He was a man of medium height and sturdy frame, with keen, blue-gray eyes and a smile which broke into a friendly chuckle during his conversations. Dr. Stratton had a keen sense of humor and enjoyed anecdotes.

From 1886 to 1889 he was instructor of mathematics and physics at the University of Illinois. He was promoted to assistant professor of physics in 1889, and occupied the chair of professor of physics and electrical engineering from 1889 to 1892. During that year he left the University of Illinois to become assistant professor of physics at the University of Chicago, being raised to associate professor in 1895, and to professor in 1898.

For a number of years Dr. Stratton had been interested in the establishment of a National Bureau of Standards at Washington, and in 1900 he brought this matter to the attention of Lyman J. Gage, who was then Secretary of the Treasury. Dr. Stratton was asked to draft a bill for the establishment of such a bureau, and it was largely through his efforts in bringing the matter before Congress that the bill was passed on March 3, 1901. He was then appointed Director of the new bureau and served in that position until 1923. The Bureau of Standards grew from a very small institution, employing a few workers in science and housed in temporary quarters near the Capitol, to what is considered the foremost research institution in America, with a staff of 900 employees and a large group of splendid buildings.

In 1923 Dr. Stratton was asked to become President of the Institute, and from that time until 1930 he served with distinction as the chief administrator of the Institute. In 1930, at his suggestion, the Corporation decided to divide the heavy responsibilities of administration of the Institute, and Dr. Karl T. Compton, noted physicist, became President. Dr. Stratton then became Chairman of the Corporation, a position which he occupied at the time of his death.

Dr. Stratton graduated from the military course at the University of Illinois with the rank of Captain, and from 1895 to 1901 served first as Ensign, then as Lieutenant Jr. Grade, Lieutenant, and finally as Lieutenant Commander of the Illinois Naval Militia. During the Spanish-American War he served from May to November, 1898, as Lieutenant in the U. S. Navy, and from 1904 to 1912 held the rank of Commander of the District of Columbia Naval Militia.

In addition to the degree of Bachelor of Science from Illinois, Dr. Stratton held the honorary degree of Doctor of Engineering from the University of Illinois, 1903, and the honorary degree of Doctor of Science from the University of Pittsburgh, 1903; the University of Cambridge, England, 1909; and Yale University, 1919. He was an officer of the Legion of Honor, and received the Elliott Cresson Medal of the Franklin Institute and the Welfare Medal of the National Academy of Sciences. He was an honorary member of the Society of Sigma Xi, Tau Beta Pi, Phi Beta Kappa, and was also a member of the Council of National Defence, National Advisory Committee for Aeronautics, the International Committee on Weights and Measures, Interdepartmental Board on Ice Observation and Patrol, American Section of the Standardization Committee of the International Chamber of Commerce, Federal Specifications Board, National Screw Thread Commission, and was U. S. Delegate to the International Electrical Congresses, St. Louis, 1904, and London, 1909.

Dr. Stratton was a member of the following scientific and engineering societies: National Academy of Sciences, National Research Council, American Philosophical Society, American Association for the Advancement of Science, Washington Academy of Sciences, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Society for Testing Materials, National Aeronautical Association of U. S. A., and an honorary member of the Optical Society of America. He was also a member of the American Physical Society and the American Engineering Standards Committee.

Dr. Stratton is survived by three sisters, Mrs. C. S. Newcomb and Miss M. E. Stratton of Pasadena, Calif., and Mrs. G. M. Hobbs of Chicago.

Editorial Comment

THE Boston newspapers, as well as many others, carried editorials on Dr. Stratton. It would be fitting to reprint all of these but we select only two; first one from the Boston *Post* and finally one from the Boston Evening *Transcript*.

"The death of Samuel W. Stratton, former President of Technology and Chairman of its board of directors, coming as it did with startling suddenness, deprives the community and the nation of another fine servant. Dr. Stratton's life was one of large accomplishment before he came here to preside over the destinies of the renowned Institute across the Charles, and since his advent here he had added to his fame and his great measure of usefulness. That his final call came when he was discussing the career of the great Edison, whom he was privileged to call friend and whom he extremely admired, adds a touch of drama to his passing which he, with all his dislike of the ostentatious, would have deplored. In science and in the superb training of youth, Dr. Stratton had few equals. Boston and M. I. T. will miss him sadly."

The Boston Evening *Transcript* commented as follows: "The lasting fame of Samuel W. Stratton will rest upon his creation of the United States Bureau of Standards. It was, as he was fond of saying, 'only a blueberry patch' when he selected the sightly eminence it crowns off Connecticut Avenue in Washington, and he lived to see it become an institution absolutely unique in the service it has rendered the business and the scientific world. Fundamentally, its function was to maintain standards of accuracy in weights, measures, and so forth, for the aid of national and state governments and educational institutions, but Dr. Stratton so broadened its operation that it became the arbiter of quality and of performance for the whole business world. Its tests included every form of trial, from measuring the tensile strength of a hair to that of a crankshaft, from a study of the most economical operation of a Ford car to investigation and (*Concluded on page 102*)

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OPPORTUNITIES FOR TECHNICALLY TRAINED MEN IN THE WOOD INDUSTRIES

(*Continued from page 70*)

and evidently at a much lower cost than cellulose in any other form. It is conceivable that wood may eventually supplant even cotton. The dramatic history of American industrial chemistry, when chemists learned the secret of the "benzene ring" and industry learned how to apply it, may find in wood a Twentieth-Century parallel.

THERE has been some progress made by federal and educational research laboratories, by a few outstanding construction corporations in the United States, and by the American Institute of Architects in problems confronting the designer and builder of wood structures. The construction industries and the architectural profession are, however, far from the desired goal in devising the most efficient and economical methods of the framing, design, and assembly of wood in light and heavy construction.

It is alleged, for example, that there is no sound engineering basis for the long-established custom of spacing in building construction joists, studs, and rafters 16″ on centers, or in the lighter types 24″ on centers. It is even said that the practice a century and a half ago in the New England States of cutting trees into four-foot bolts established the standard length of 48″ for plaster lath. Then in using the lath in buildings it was found necessary to space partition and side wall studs at distances which could be spanned by two or three laths without cutting the lath. A 16″ or a 24″ stud interval led naturally to similar spacing between joists and rafters. The situation now confronts the structural engineer, architect, and builder as to whether this spacing is proper from the standpoint of the strength and rigidity of the resulting structure.

The engineering profession, largely through work of the U. S. Forest Products Laboratory, has known for years the exact working stresses in bending, in compression perpendicular to grain, in compression parallel to grain, and in other important structural properties for each wood used for structural purposes and for each standard quality in that wood. The engineering profession has not known, however, how much of the strength of the individual members of a bridge or building may be lost by inefficient or incorrect methods of fastening these individual members together in the structure. Here alone the structural engineer and the architect have a large field of usefulness, not only in arranging and conducting scientific laboratory tests of built-up assemblies of known strength and stiffness so far as the individual wood members are concerned, but also in the actual erection of buildings, bridges, and similar structures.

For many years the generalized statement was made that diagonal sheathing on the outside walls of buildings furnished greater strength and rigidity than sheathing horizontally applied. The building industries could not prove this statement, nor tell how (*Continued on page 92*)

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OPPORTUNITIES FOR TECHNICALLY TRAINED MEN IN THE WOOD INDUSTRIES

(Continued from page 90)

much stronger the former type of construction was. The National Lumber Manufacturers Association arranged and financed a series of systematic tests at the Forest Products Laboratory to obtain authentic and tangible research data on this question. To the satisfaction of manufacturers, architects, and builders alike, these tests revealed the fact that ordinary stud and plate walls, sheathed diagonally, are four to seven times as stiff and seven to eight times as strong as horizontally sheathed. This research brought to light other timely facts on nailing, methods of wall bracing, and the important stiffening influence of even wood lath and plaster.

Much has been said, some of it justifiably, but more often in exaggeration, of the fire hazard of wood construction. There has been agitation for the so-called "fireproof" first floor, offered on the premise that 90% of the fires in dwellings originate on the inside of the dwelling and 80% of these fires start in the basement. Why, then, competitors of lumber argue, is not fire hazard in lumber construction reduced to a minimum if the basement ceiling or first story floor is made of incombustible materials? Recognizing a problem which lumber manufacturers should frankly confront, the National Lumber Manufacturers Association now has under way at the University of Illinois a series of tests on the possibilities of the laminated type of wood floor. Early results more than justify the foresight. It is found in these tests that a laminated floor made up of two by fours in light construction, or two by six and eights in heavier construction, laid on edge and tightly bolted or nailed together, will offer a floor not only of equal stiffness and solidity but also of a fire resistance equal to that of the so-called incombustible type of floors.

The preliminary research which has been inaugurated in methods of treatments to make wood fire-resistant so far confirm the prediction that lumber fire-retardant-treated in place of the present forms of masonry may be extensively used as fireproofing material around steel beams and around columns in steel construction. Beautiful building interiors will be built anywhere of fireproof lumber. Moisture-proof wood is in definite and early prospect.

As I have pointed out, 60% of the standing trees are not at present commercially utilized. It is true that the lumber industry, under that handicap, using valuable and costly materials, and confronted with the early necessity of conserving and regrowing them, cannot be expected permanently to maintain a strong position in competition with other industries more efficient in the conservation and in the use of their resources. But it is also true that the permanent status of the lumber industry will not be determined until science and industry together, and much more extensively than has heretofore been done, shall have explored the possibilities of improved utilization of wood.

The lumber industry is becoming aroused to this fact. Those who have relegated the lumber and wood-using industries to early commercial discard have, in my

judgment, reckoned prematurely. The greatest competitor of any industry today is change. No industry is immune. No industry, because of the wide range of qualities and adaptability of its products, has a greater opportunity in the long run to meet successfully this competition of change than have the diversified wood industries.

If, as I firmly believe, it can be, the objective of which I have spoken is accomplished (and science alone can pave the way), the wood industries will have made secure a wide range of markets and uses for their products; they will have greatly enhanced the value of standing timber, our greatest and our only reproducible natural resource; they will have the only effective economic incentive to reforestation of timber lands by private enterprise; they will have insured a valuable, permanent, productive use to one-fourth of the land area of the United States; and, what is more, they will have vastly increased the opportunities for profitable commercial and professional employment.

BENJAMIN THOMPSON: COUNT RUMFORD

(*Continued from page 75*)

of being important. As under-secretary of state he had been insatiably curious about gunpowder. The rural scene in England which Lord George Germaine considered suitable for week-ends was for Thompson the opportunity to experiment with cannon and with ammunition. When Sir Charles Hardy of the British navy invited him upon a cruise, it was no joy-ride but an opportunity to satisfy this same curiosity about naval ordnance and its efficiency. The experiments with gunpowder were continued upon the voyage to America with the same curiosity. They were resumed in Bavaria and there were made with an accuracy as intense as the interest in the subject.

Such a man made a great minister of war. But it was when he left the exclusively military things like gunpowder and cannon, and turned to the commonest matters of human usefulness, that his genius touched its height.

Lord Brougham poked fun at Rumford because in a serious book in print the latter gave a page and a half to the best way to eat hot Indian pudding. To Brougham these explicit directions appeared ludicrous:

"The hasty pudding being spread out equally on a plate while hot, an excavation is made in the middle of it with a spoon, into which excavation a piece of butter, as large as a nutmeg, is put, and upon it a spoonful of brown sugar, and so on; the butter, being soon heated by the heat of the pudding, mixes with the sugar and forms a sauce, which being confined in the excavation, occupies the middle of the plate! Dip each spoonful in the same before it is carried to the mouth, care being had in taking it up, to begin on the outside, and near the brim of the plate, and to approach the centre by gradual advances, in order not to demolish too soon the excavation, which forms the reservoir of the sauce!" (*Continued on page 94*)

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BENJAMIN THOMPSON: COUNT RUMFORD

(*Continued from page 93*)

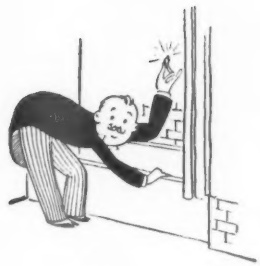
But any one who will follow Rumford through his studies of human comfort in small matters by the means of his application of curiosity, accuracy, and thoughtfulness to the substantial results will prefer to laugh at Brougham.

Rumford did not limit himself to hasty pudding. He considered nothing in daily life too common or too ordinary to observe or too unimportant to improve. For instance: "When dining," says he, "I had often observed that some particular dishes retained their Heat much longer than others and that apple pies remained hot a surprising length of time." Fortifying this experience by the fact that he burnt his mouth, and observing that he had done it with rice soup, he founded thereupon his essay "Of the Propagation of Heat in Fluids," winding up with the conclusion that "Heat passes with much greater difficulty or much slower in stewed apples than in pure water." Science and humanity both owe Rumford a heavy debt for reaching far earlier than most scientists the conclusion which he thus embodied in common words. If you had asked Huxley what he thought of Rumford and what he thought of Brougham, you would have had no doubt which he considered the man of genius. The truth was, as Rumford said, that he could not possibly live without constant speculation and inquiry. Whether he was asleep or awake

> "the object of my speculations is so present to my mind, however busy I may be with other affairs, that everything taking place before my eyes having the slightest bearing upon it immediately excites my curiosity and attracts my attention. My relations at the court of Munich, and that, too, with a prince who was much interested in the promotion of knowledge, afforded me during a period of four years abundance of leisure to pursue almost without interruption my physical investigations."

DURING the period of his career which we are now beginning to describe, Count Rumford placed at the service of mankind this wonderful combination of genius and simplicity, erudition and its application to common things. And in the first instance he placed it at the service of Bavaria, the government of which was now dominated by him. It had, at any rate, none of the disadvantages of democracy. Both king and minister were thorough despots.

Being by training a military man and Minister of War at that, Thompson naturally began with the army and tried his first experiments there. Going back to fundamentals he philosophized about what an army should be in a perfect community. He concluded that it should be one which would "unite the interest of the soldier with the interest of civil society and render the military force even in time of peace subservient to the public good." He therefore sought to make his army a body skilled in the arts of peace, productive of wealth, a body of men well educated, who should permeate the entire civilized community with beneficial influence. And consequently the privates soon corresponded very closely to the field agents of the Department of Agriculture as we see them in these United States (*Continued on page 96*)



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BENJAMIN THOMPSON: COUNT RUMFORD

(*Continued from page 94*)

today. For three days out of four in peace time the privates were free for civilian work. Through them took place that free distribution of seed which was as sound in politics and agriculture in the one century as it is in the other. Among the seeds were cuttings of a curious tuber called "potatoes." At that time on the continent of Europe this thing was suspected and regarded with contempt, aversion, and fear of poison. The French law forbade its cultivation. Gilbert White in his "Natural History of Selborne" distinguishes landlords, and points out that the enlightened ones had been able to persuade the English peasant that the potato can be eaten without danger. How shall we measure the debt of Europe to a philosopher, a good advertising agent, and one from whose sphere of activity in Bavaria the potato went out as a messenger of civilization?

Then, too, a necessary part of an army like this was a good school; so he provided one for all the privates. Every soldier had a garden plot as a reward of virtues. Those of us who have passed through the developments of army life in the great World War and remember the enlistment of the civil population may draw a parallel from our personal experience.

AND before long even in peace Rumford found a dangerous enemy which he conquered with his army. In Bavaria beggars were legion. Their quantity and quality had become intolerable. Previous rulers had thoughtlessly permitted begging to become slightly more agreeable than working. Then greatly to their surprise cause produced its natural effect. Socialistic experiments of this sort run true to form no matter what the century. The people who received a sufficient out-of-work dole began to leave work and to become a true leisure class. I should say they were an intolerable nuisance, and Count Rumford calls them "detestable vermin." In Munich one could not cross the street without being threatened, and very likely assaulted by noisy, healthy, and insolent beggars demanding alms and insisting upon obedience to their demand. But they were living under a minister of war, in substance prime minister — under a shrewd Yankee philosopher who had the powers of despotism. And so he marshalled his army against them and planned his attack. The consequences were the abolition of beggary and the invention of the common kitchen range.

The army was naturally available. It was spread out over the whole of Bavaria with a distribution ideal for this purpose. The private soldiers were mail-carriers, news-gatherers, customs guards, and police. Their knowledge and their presence went into every hamlet in the land. The philosopher pondered deeply, considered his plans at every angle, organized his campaign, and then struck. At one sweep he arrested every beggar. He had already determined to put each one to some useful employment, and had made all necessary preparations.

And he was a good advertising agent. Just as President Hoover might open a new water-power development by pressing an electric button, so (*Continued on page 98*)

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BENJAMIN THOMPSON: COUNT RUMFORD

(*Continued from page 96*)

Rumford, the Prime Minister, commenced the arrest of beggars with all due ceremony in the presence of important and aristocrat witnesses, and gave the movement such *éclat* that every citizen was "sold to the idea" and gave his coöperation. Within days, rather than weeks, every Bavarian beggar was studying cause and effect in its simplest form. He who will not work, neither shall he eat. But the beggar was not uncomfortable or enslaved. Rumford's ingenuity and foresight had planned food, lodging, and occupation. And the plans were as wise and as fully detailed as the plans for the proper consumption of hasty pudding. There was a particular soup, the recipe for which I can supply, and it was to be followed by a particular prayer to be repeated by all beggars in barracks after the soup had been served and before they were allowed to eat. He had only to establish that it was more agreeable to work under supervision than to beg and be arrested and starved into submission. That was an easy lesson, and the beggars learned it. Moreover, Rumford again ran true to form when he taught the world his lesson with a wealth of exposition, of simplicity, and of confidence in his cause which for once brought the under-dog into sympathy with what was being done to him. This Yankee Protestant unbeliever fell ill, shortly after this period, and the entire body of ex-beggars of the Bavarian countryside went in a procession to a Catholic cathedral, where a mass was celebrated for his recovery.

And there was money, too, in this business of administering the beggars. When the experiment had been working for a year, the Elector of Bavaria was in red-ink figures. He had invested in the beggars, net above their earnings, national funds to an amount exactly stated by Rumford and calculated out as ten dollars per beggar. But when the experiment had run for five or six years all but about 1,400 beggars had been absorbed into the community, and this remainder brought in a net profit of $30 *per annum* per beggar.

ANOTHER man might have rested upon his laurels. But Rumford could not do this job and devote his mind and his inventive powers to its successful accomplishment without going forward with results. The very circumstance of his greater wisdom arising out of this task drove him to do more. And here, of all unlikely places, we find the birth of the kitchen range. Who would suppose that it was invented by a prime minister of Bavaria strictly in the line of his duty of disciplining beggars? But beggars must eat, food must be cooked for them, fuel must be used in the preparation of this food, and there is a subject which Rumford was capable of handling with erudite and practical consideration. He went to the bottom of the pot and below that to the fire itself, using his philosophic mind everywhere. Beginning with the soup, he found that he could feed a thousand beggars on soup at a cost for fuel per beggar per day amounting to 1/111th part of a penny. The raw materials for his soup were barley, peas, potato, and bread. But owing to the prejudice against potatoes in Bavaria and the difficulty in getting them accepted for food, this material cost 422 twelve-hundredth parts of a penny per dinner until Rumford "put over" the potato on Bavaria. Then the cost fell to 410 sixteen-hundredths of a penny. Later, when he had come to live in London, Rumford wrote an essay upon this subject. The costs in London were a bit higher. The final cost there for a single poor man's dinner was 2,951 twelve-thousandth parts of a farthing. But by the time that Rumford had reached London this was not a matter of beggars and poorhouses, of Mr. Bumble and that sort of thing. It was an invention which was affecting civilization itself. Dearth and famine came after the Napoleonic period, but that famine was very largely ameliorated by Rumford's genius. Lord Hawksbury in the House of Lords laid it down that one-third more nourishment could be got out of food by Rumford's methods, that is, over and above the best result previously obtained. So one man's brains and genius and common sense had made it possible for three people to produce the food which previously had required the labor of four, and thus set one food producer free to produce wealth and comforts. All over the world these tremendous results were freely acknowledged and used. But Rumford in Bavaria did not stop even at this point. He had begun with an efficient army. He had applied that army and his genius to the abolition of beggary. He had gone on to turn the burden of the beggars into a profit to the nation. He had won that profit probably through the use of soup. Better still, he had produced a soup that Oliver Twist would have enjoyed, and at any rate something which made beggars grateful to him. These steps being accomplished upon a scale of world-wide importance, he carried his victory forward and reformed our domestic cooking. We know the difficulty of introducing any innovation when the new thing has to be used by every housekeeper. It would be idle to pretend that perfection in the use of fuel is even now in sight, but the difference between the way fuel was used when Rumford began and the economies of fuel after his work had taken effect is a difference brought about with a swiftness not known either before or since in domestic economy.

HOW did he go about it? First, he observed that when soup was cooked according to the ordinary Bavarian style, it took a certain number of cubic inches of fuel which he standardized and measured. Likewise, it took a certain number of minutes to prepare and cook the soup over the open fire made with that fuel. It was not new to think of confining heat and directing it entirely against the thing to be heated, but it was certainly new that a prime minister should attempt to persuade substantially all thoughtful cooks to use the idea. Rumford came at once to the enclosed fire and brought the world after him. And he did this because he thought profoundly and carefully about the process of heat, and simply and sensibly about its use by cooks. Professor Youmans, looking back over the history of science, tells us that Rumford was the first man who took the question of the nature of heat out of the domain of idle speculation, such as it had been in since the days of Aristotle, and dealt with it upon the true basis of actual physical experiment.

The obituary memoir of Rumford in the "Gentleman's Magazine" calls attention to the philosophizing which Rumford did. "He repeatedly declared to me," so the author says, "that it was his decided opinion that heat and light were the results of vibrations in bodies and were not bodies themselves." At the time when Rumford made this assertion he was as far ahead of the rest of the world as if he had invented wireless or the telephone. But it was not enough to be ahead of the rest of the world; it was necessary to be in touch with every kitchen and to be familiar with every chimney and to have a serious and sensible power of convincing cooks. All that he contributed to this improvement.

We find it fully described in an "account of the Kitchen fitted up at the Foundling Hospital [in London] under the direction of His Excellency Count Rumford." This kitchen contained a roasting machine which would roast 112 pounds of beef using a peck of coals supplemented by a peck of cinders from the previous day. The previous use of coal had been of ten times that quantity. There were two pipes which forced hot air over the meat so as to control the browning. Then there was a steam-box for boiling meats, greens, and potatoes. And in a cook's shop, on land of the Foundling Hospital in the colonnade north of Upper Guilford Street, there was a place where you could buy tickets for the soup kitchen. Such were the Rumford cooking devices when they appeared in London. We know also what their arrival in New England was like. The learned Mr. Chief Justice Parsons, reading in his foreign books and observing some imitations of Rumford or importations of parts of his apparatus, became convinced of the "success of Count Rumford's apparatus for cooking, imported a complete set . . . and very proud he was of this apparatus." So his son records in the excellent biography, which goes on:

"The difficulties springing from the novelty of it and the ignorance of our cook he overcame by the most patient instruction, until at last everything went well. Thereupon we had a large dinner party for which the new cooking apparatus proved entirely adequate. . . ."

But no matter how great the comfort which was created by the domestic device, we should never think of it as a single and isolated invention. It was one of the many results of Rumford's sound philosophizing about the nature and application of heat. He studied ordinary fireplaces and chimneys and wrote an essay about them. Any client of any architect can today insist upon having Rumford's directions followed. The architect will probably have a copy of the "Chimney Fireplace" essay, and if he will obey its directions no chimney need smoke. No automobile would work today were it not for progress in the study of heat made by Rumford and gratefully recognized by scientists. Huxley pays his tribute to Rumford on this particular point, using the Count as the proper type of the helpful inventor. "What simpler and more practical," says Huxley, "than the attempt to keep the axle of a wheel from heating when the wheel turns around very fast? How useful for carters and gig drivers to know something about this! and how good it were if any ingenious person (*Concluded on page 100*)

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BENJAMIN THOMPSON: COUNT RUMFORD

(*Concluded from page 99*)

would find out the cause of such phenomena and thence educe a general remedy for them. Such an ingenious person was Count Rumford."

SOMETIME I hope a really good biographer will describe the whole of Rumford's career, including his happy and useful later life. He lived and flourished in London, where he founded the Royal Institution. Later he lived in Paris and pursued his scientific researches there. He never went back to America, but he always kept a patriotic feeling for his country and was the founder of the American Academy of Arts and Sciences and of the Rumford professorship in Harvard University. In his later life there was naturally some eccentricity. His house in Brompton near London, for instance, had double windows constructed in imitation of those which he had seen in Germany, Sweden, and Russia.

Before long, however, Rumford decided that he preferred Paris, and there he spent the later years of his life. He married, and then had lively quarrels with, the widow of Lavoisier, the famous chemist. One scarcely wonders that he retired from association with that particular lady to a comfortable home in the suburbs of Paris, where his associations were less reputable, but freer from quarrels.

Another great scientist, Cuvier, passes a post-mortem verdict upon all this with the skill with which the Frenchman applies the scalpel of words. It is what the French call an *éloge*, but —

"He was no democrat. His services to his fellow men were rendered them without loving them or even thinking well of them. He felt that the common people should not be trusted with the care of their own well being. He loved slavery as if he were the owner of a plantation and China seemed to him to have a nearly perfect government because its common people were absolutely in the power of its men of education."

Cuvier then goes on to tell us that, regardless of all consequences, Rumford's behavior throughout life was "modeled upon his passion for order." "Doubtless," reflects Cuvier, "this was a good way to be effective, but it certainly was not the way to be agreeable in the society of his equals." And the biographer of his wife neatly remarks that she "had to be gracious for both." Thus Rumford threw away all those opportunities for great popularity which his service to mankind had opened for him. One really ill-natured biography, such as only an ill-natured and laborious scientific rival could produce through painful effort, asserts that Rumford's fame "induced him to display without reserve those dispositions which he had hitherto been at some pains to conceal," and that the result was arrogance. There was some quarrel, very likely with this writer and arising out of some one's arrogance, which led Rumford to abandon the Royal Institute, the favorite child of his scientific life, and to desert London for Paris. And now he has nearly disappeared from history.

I think it is largely because he always had a kick ready for the under-dog.

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WINGÉD WORDS

(*Concluded from page 67*)

it up, which displaced *stride out churl. To take off* for somewhere is common, as is to *get off the ground*, the latter in the place of *to make the grade. Crack up, flat spin*, and *down wind* have each a general value and a limited but growing following, and scores of the straight nomenclature words have been broadcast by the newspapers for a decade. Sometimes the public have made a use all their own of an aeronautical term. I have several times heard the expression *air-cooled teeth* for what were formerly called *buck teeth*, and must claim it as a result of the popularization of the air-cooled, radial engine by our later-day flying heroes.

As growing as its effect on popular speech is the context of the jargon itself. New words are continually needed to describe more accurately the latest developments. Take the autogiro as an example. There is no word which describes satisfactorily its nearly vertical descent into a small field; certainly the usual airplane word *glide* does not convey it. Why not turn to that great source-book for mathematicians and astronomers, "Through the Looking-Glass"? There we find:

"'T was brillig and the slithy toves
Did gyre and gimble in the wabe."

Now *gyre* would be good for the act of flying an autogiro, so why not *gimble* for the vertical descent? *Brillig* describes the kind of weather and *wabe* the kind of territory tough for airplanes, but all right for autogiros. And *slithy toves?* Why, they are the sort of people who would go flying in one, of course, you numskull.

THE DEATH OF CHAIRMAN STRATTON

(*Concluded from page 88*)

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THE TABULAR VIEW

SO MUCH misleading information about nutrition has been distributed to the American reading public that the average layman is hard put to discriminate between the genuine and spurious. The Review asked Dr. MORRIS FISHBEIN, Editor of the *Journal* of the American Medical Association, to prepare a paper which would help the intelligent reader to a sound and sane attitude toward food and to warn him against the charlatanism and misrepresentation that beset all of us on every side. Too many people think of food in terms of quantity only, yet nutritional chemists are proving beyond all doubt that the quality of foods has an enormous effect on the human economy. "One of the most impressive features in recent discoveries regarding the relations of food to health and vitality," writes Dr. H. C. SHERMAN, "is that the benefit of better feeding usually becomes fully apparent only when it is continued throughout a large part of the life-cycle, and often the benefit is greater to the second generation than to the first. . . . Through simply a wiser emphasis in the daily choice and use of ordinary staple foods, there may result improvements in the vitality of the individual or the family, all within the bounds of normal nutrition, but of very real significance for the maintenance of health or for recovery from disease. . . . As there has been so strong a tendency to attribute longevity entirely to hereditary factors, it may be worth while to emphasize the fact that . . . the influence of food on longevity is demonstrated with such degree of mathematical certainty as is represented by 'chances' much better than 10,000: 1, or with a hundredfold greater certainty than is usually considered necessary for the conclusive establishment of such scientific observations."

JOHN R. FREEMAN is one of America's great engineers. In fact, in a recent selection of the ten greatest American engineers he was, of course, included in the list. A survey of his prodigious accomplishments easily explains why. Early in the year a testimonial dinner was given Dr. Freeman by fellow American engineers and by citizens of Providence. Many of the latter, knowing him to be President of the Factory Mutual Fire Insurance Companies, were astonished to learn that he was even more eminent and active as a civil engineer. As a matter of fact, Dr. Freeman considers his great achievement of welding together the Factory Mutual system as minor to his work in hydraulics, seismology, and civil engineering in general. In his earlier days, he made many fundamental contributions to hydraulic engineering, and during his long career as a consulting engineer, he has advised on the locks and dams of the Panama Canal, the Grand Canal in China, and the Keokuk Dam on the Mississippi. He has served the Canadian Government as consulting engineer on water power conservation, and the present renaissance in hydraulic study and research in this country is almost wholly the result of his efforts. It was due to his influ-

(*Continued on page 108*)

The Bath Tub Murder

By Mrs. L. R. Dooley, Tulsa Junior League. One of a series of TIME advertisements prepared by Junior Leaguers.

In 1793 revolutionary terrorists controlled France. The Girondins (idealistic moderates) had been defeated. Three men ruled Paris: Danton with his Cordeliers, Robespierre with his Jacobins, and one who was too suspicious, too sincere for party attachment, Jean Paul Marat.

Marat, at this time near death from a painful skin disease contracted in two years of hiding from political enemies in the sewers of Paris, was confined to his home. There, burning with his malady, his political spleen, his consuming energy, he spent his days in a treated bath, compiling his daily pamphlets. He was so engaged on the late afternoon of Saturday, July 13, 1793.

As TIME, had it been published in 1793, would have reported subsequent events:

. . . Long a sufferer from pruritis (malignant eczema), Jean Paul Marat, 50, Swiss M.D., potent revolutionary pamphleteer, erstwhile pill-mixer in England, ingenious experimenter in physics, correspondent of the late great Ben Franklin, was accustomed to write his daily "Journal de la Republique Francaise," receive visitors, in the bathroom of his Paris apartment. There, soaking in the medicated waters of a shoe-shaped bath, a sheet to pull about his shoulders, a writing-board across his knees, he found surcease from his affliction, prepared with some composure lists for the guillotine. Above him, on the wall, were a map of France and two pistols; above the pistols the written words: *"La Mort."*

To this apartment, with its strangely-used *salle de bain*, came last week a fresh-faced country miss. Pleasantly she gave her name: Marie Anne Charlotte Corday D'Armont; her business, news from Caen, where Marat's exiled foes, the Girondins, had fled. (TIME, June 10). She was unwillingly admitted, escorted to the bath by Marat's housekeeper and common-law wife, one Simonne Evrard. Left alone, they talked: the neatly-gloved caller, handsome in ash blond hair, white bonnet; the naked, repellently-ill patriot.

Shortly Simonne Evrard heard a feeble cry: "A moi, ma bonne amie, a moi!" Bursting in, she found Pamphleteer Marat stabbed, dying, the bathwater fouled with blood. Vainly she tried to stop the flow with her hands, screamed shrilly for help which quickly came.

Aloof, poised, Assassiness Corday did not resist arrest.

Questioned, Mlle. Corday, 24, convent-trained, descendant of Dramatist Corneille, admitted the killing, insisted she was no common murderess; surrendered from beneath her fichu her baptismal certificate pinned carefully to an heroic manifesto flaying Marat's terrorism; also a sheath for the fatal ebony-handled dinner knife, purchased the day before for two francs.

On trial July 17th, asked by dread Prosecutor Antoine Fouquier-Tinville if she had practiced the death-blow (the knife penetrated neatly between 1st and 2nd ribs, pierced lung and aorta) Mlle. Corday replied, indignant: "The wretch! He takes me for an assassin!"

Condemned, she refused a priest, spent her last hours posing for Portraitist Hauer, his payment a lock of her shorn hair. Then, in red chemise, she began the jolting journey through rain to the guillotine. . . .

Cultivated Americans, impatient with cheap sensationalism and windy bias, turn increasingly to publications edited in the historical spirit. These publications, fair-dealing, vigorously impartial, devote themselves to the public weal in the sense that they report what they see, serve no masters, fear no groups.

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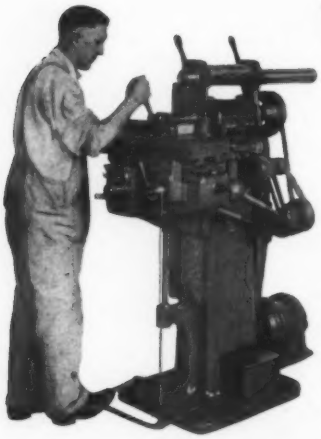

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THE TABULAR VIEW

(Concluded from page 106)

ence, for instance, that Congress voted the appropriation for constructing an international hydraulic laboratory at the Bureau of Standards. He has sent many young men to Germany to study in the great German hydraulic laboratories, and he has served in an advisory capacity in the establishment of the Institute's hydraulic laboratory. Carrying his interest still further, he has financed the publication of a notable book, "Hydraulic Laboratory Practice," and is now sponsoring the publication by the Institute of a series of translations of German hydraulic titles. ¶Besides his degree from M.I.T. in 1876, Mr. Freeman holds honorary doctor's degrees from Brown (1904), Tufts (1905), *Sachs Technische Hoschule* (1926), the University of Pennsylvania (1927), and Yale (1931). He has been a member of the Corporation of the Institute since 1893. In 1929 he received an honorary fellowship from the Polytechnic Institute of Karlsruhe, bestowed "in recognition of his pioneer activities as a many-sided engineer in prominent scientific research and his service for the international promotion of hydraulic systems." He was designated in 1927 by the Federal Government as its representative to the Third International Congress of Scientific Management in Rome, and in 1928 he was a member of the Committee of Eighty sent to the World Engineering Congress from America. He has been President of the B.S.C.E. (1893), of the A.S.C.E. (1922–23), of the A.S.M.E. (1904), and he is a fellow of the American Academy of Arts and Sciences.

MR. ROSSMAN'S article on page 117 "Do Engineers Invent?" is presented by The Review without comment, but with the expectation that our readers themselves will furnish adequate comment. Mr. Joseph Rossman is a new contributor to The Review. He is a chemical engineer and a member of the United States Supreme Court Bar. For the last eight years, he has been Patent Examiner in the U. S. Patent Office and Editor of the *Journal* of the Patent Office Society, the only periodical in the country which deals with patent law and related subjects. Mr. Rossman is a graduate of the University of Pennsylvania in Chemical Engineering, receiving his LL.B. and M.A. from George Washington University, and his Ph.D. from American University. He has written much, having contributed over 60 articles to technical journals. His book "The Psychology of the Inventor" is allied in feeling and thought to the subject of his article in The Review, and the research necessary in preparing this book gave him an authoritative background on which to base his conclusions on engineering inventiveness. He obtained first-hand information from a group of over 700 inventors, from such well-known men as Elihu Thomson, Reginald Fessenden, John Hayes Hammond, Jr., and August Smedh. This material was supplemented by questionnaires sent to patent attorneys in the United States and to research departments of the large corporations.